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Edited by H. H. Brown, A. M. Inst. N. A.
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The Clyde Line Coastwise Steamship Lenape

A noteworthy addition to the American coastwise fleet is the steamship *Lenape,* built recently for the Clyde Steamship Company, New York, by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., under the supervision of and from designs prepared by Theodore E. Ferris, naval architect and engineer, New York, in collaboration with H. H. Raymond, vice-president and general manager of the Clyde Steamship Company. The vessel was built under special survey for classification by the American Bureau of Shipping to Class A-1 for twenty years for coastwise service. The principal dimensions of the vessel are as follows:

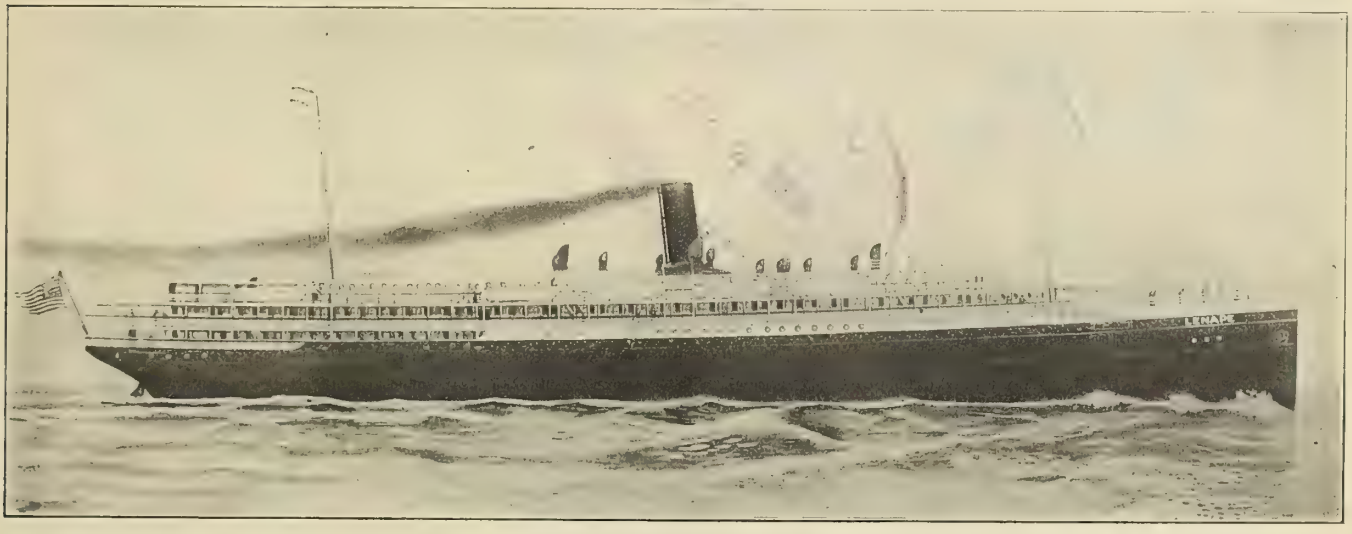


FIG. 1.—THE NEW CLYDE LINER

	Feet
Length from fore side of stem to after side of rudder post	383
Length over all	397
Beam, molded	50
Depth, molded to hurricane deck	30
Depth, molded to main deck	22
Load draft	17

Hull Construction

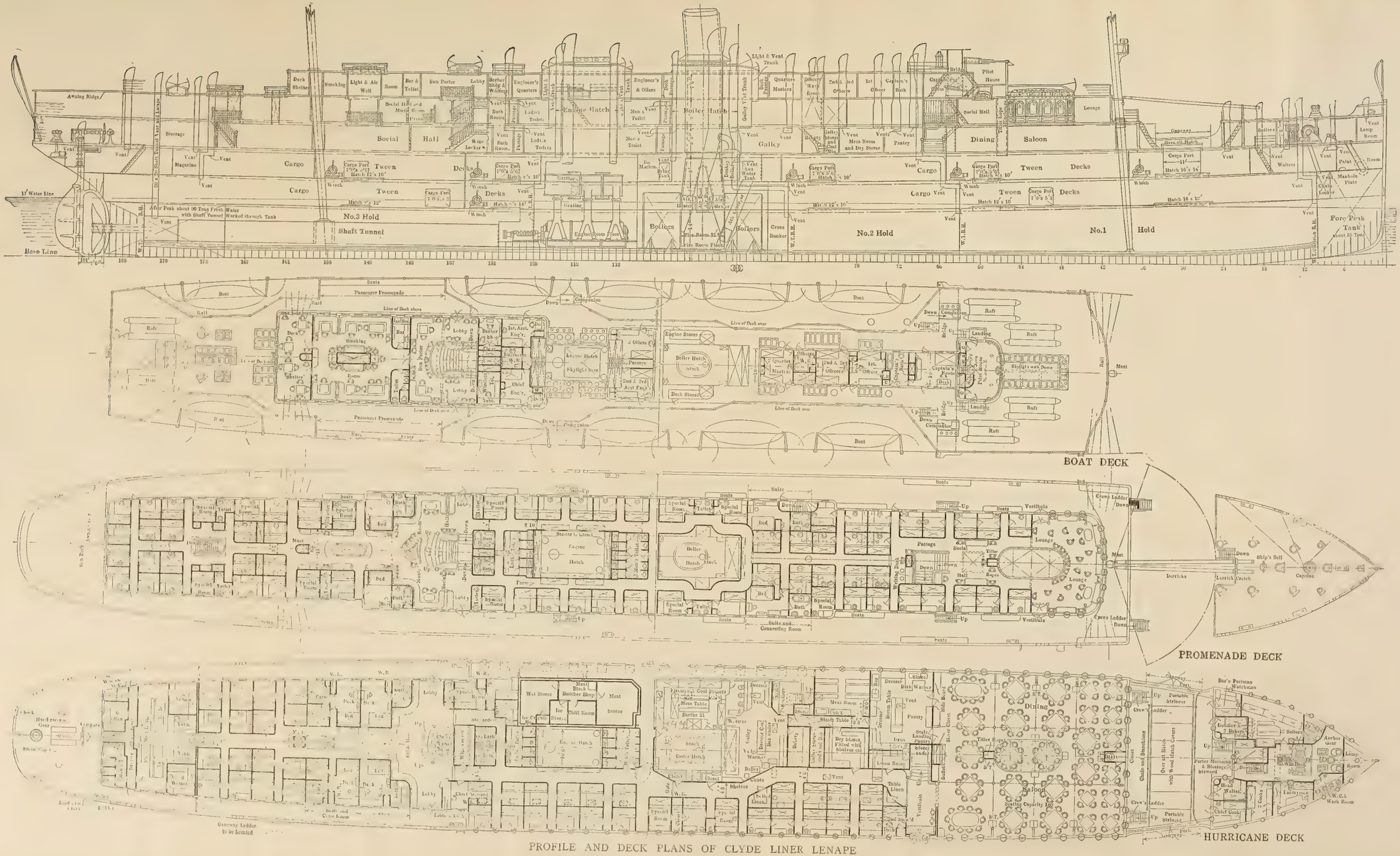
The *Lenape* is a hurricane-deck type vessel with a single bottom. The hull is divided by five watertight transverse bulkheads into six watertight compartments, including three cargo holds and the machinery space. The general arrangement and type of construction are shown in the 'midship section and plans of the ship. Both the lower and the main decks are complete steel decks; the hurricane deck is partly of steel sheathed with Oregon pine and thoroughly calked. A new feature for American coastwise ships is the inclosed bridge amidships.

As can be seen from the plans, the vessel has a raised forecastle head, the side steel structure of the ship is carried up to the promenade deck. The deck-house, aft of the bridge inclosure, is also of steel. The house above, however, on the promenade deck is of wood, and the pilot house, officers' quarters, the house containing the sun parlor, smoking room and deck shelter are also of wood, and are located on a wood deck.

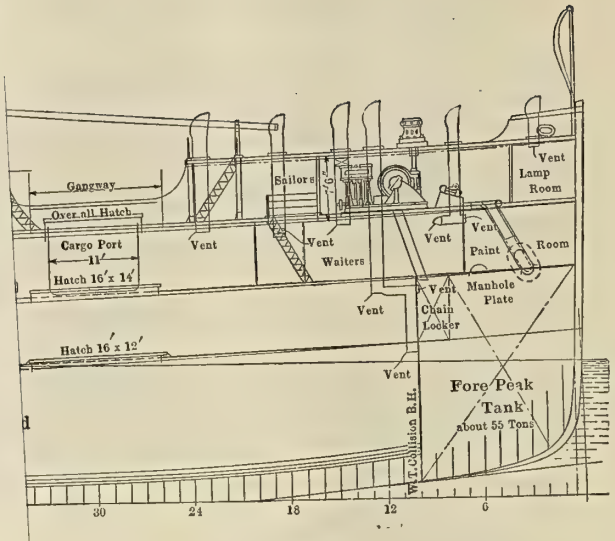
The entire hull below the hurricane deck, except for the space required for the propelling machinery and coal bunkers, is devoted entirely to cargo. The whole space available for cargo amounts to 295,000 cubic feet, giving the vessel a dead-weight cargo capacity on a 17-foot draft of 2,700 tons. On this draft the ship has a displacement of 6,250 tons.

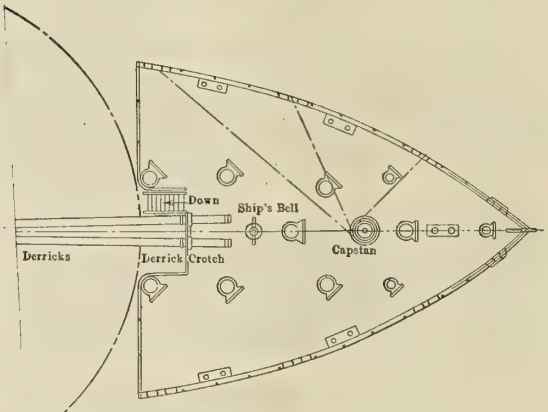
The *Lenape* has side cargo ports at the upper and lower 'tween decks, as shown on the plans, and also cargo hatches as shown. For handling cargo the forward mast is rigged with two 10-ton cargo booms with attachments and fittings for a 30-ton boom. The after mast is equipped with two cargo booms of 5 tons capacity. In addition, for auxiliary use, there is a coaling or cargo boom which is carried stowed on the deck of the ship and used for handling cargo at No. 3 port or for coaling the ship. The bunkers, arranged as shown on the plans, have a capacity of 478 tons. The ship has peak tanks forward and aft for fresh water; the capacities being respectively 45 tons and 94 tons.

The cargo holds and 'tween decks are ventilated by means of mechanical ventilation obtained by electric-driven fans and air ducts, by which is maintained at all times the thorough ventilation essential for carrying fruit and perishable cargo. There is also natural ventilation to all cargo spaces as well as to the public and private toilets, living quarters and elsewhere,

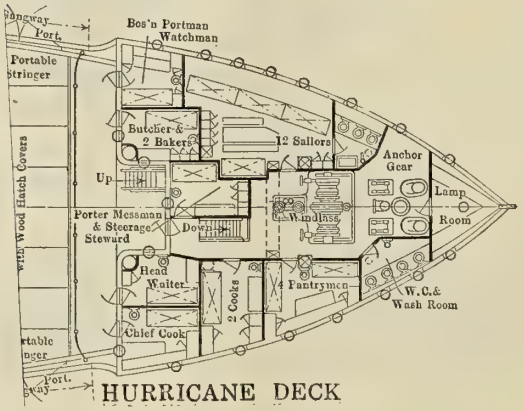


PROFILE AND DECK PLANS OF CLYDE LINER LENAPE





PROMENADE DECK



HURRICANE DECK

including the coal bunkers, all of which is obtained by means of ventilating trunks, cowls and pipe trunk ventilators. The engine and boiler rooms are most thoroughly ventilated by large cowl ventilators, maintaining a low temperature for these spaces at all times.

General Arrangement

The hurricane, promenade and boat decks are given up almost wholly to the passenger accommodations and crew's quarters. The total first class berthing capacity is 295, contained in 118 first class staterooms, eight connecting suites with baths, and eighteen special rooms with toilets and thirty connecting rooms. Accommodations for ninety-eight steerage passengers are found aft on the hurricane and main decks. The steerage quarters are made up in rooms, together with toilets, mess room and all necessary conveniences. The sailors' quarters are forward in the forecastle head, where are also

FIG. 2.—DINING SALOON

quarters for the pantrymen, cooks, head waiter, boatswain, portman, watchman, butcher and bakers, steerage stewards, etc., together with toilets, wash rooms, etc. Below the forecastle head on the main deck are quarters for the waiters, together with toilets and wash room, mess stores and the paint and lamp room.

Forward in the bridge enclosure on the hurricane deck is the first class dining saloon, with a seating capacity of 180, aft of which, on the port side, is the first class pantry, and aft of that the officers' mess room, the dry storerooms, bake shop, scullery, first class galley, linen rooms, firemen's quarters, firemen's wash room and the cold-storage rooms.

On the starboard side of the hurricane deck, amidships, aft of the dining saloon is a spacious vestibule, with the second steward's room; still further aft are first class passenger staterooms and connecting rooms, and aft of the bridge enclosure, nearly amidships on the same deck, is the lower main social hall, and then additional first class passenger accommodations.

Amidships, in way of the engine and boiler casings, on both the hurricane and promenade decks, are the public toilets and bath rooms.

Leading up from the lower main social hall is the main grand stairway of the ship, which extends up into the sun parlor on the boat deck; aft of sun parlor are the bar, a spacious smoking room and toilet, and aft of the smoking room the deck veranda.

FIG. 3.—SMOKING ROOM

The promenade deck is given up entirely to first class passenger staterooms and public rooms. Forward is a spacious ladies' lounge, aft of which is a social hall, then a large stairway leads down to the vestibule aft of the first class dining saloon. Aft on the promenade deck, between the lower social hall and the sun parlor, are the music room and a social hall. Further aft are first class passenger staterooms and suites and also connecting special rooms with toilets.

Appointments

The interior finish, furnishings, decorations, etc., of the *Lenape* mark a new era in American coastwise ships. The

FIG. 4.—SPECIAL FIRST CLASS STATEROOM

vessel also has the special features known heretofore only in transatlantic ships, including a deck veranda, ladies' lounge and public spaces of this order. The first class dining saloon is an unusually large and spacious room for a ship of this size. The decorations and finish are taken from the Adam period of design. At the sides and ends of the dining saloon

the finish is a deep, rich mahogany, with fluted pilasters extending to the ceiling, terminating in carved Ionic capitals. The space between the pilasters is old ivory white, the ceiling being finished in a cream white. At all the air ports ventilating sashes are fitted, glazed with special designs and painted glass from the Adam period of design, each window having

FIG. 5.—DECORATION AT HEAD OF MAIN STAIRWAY

an individual design. Over the center of the dining saloon is a large air well, such as is found on transatlantic ships. This well is enclosed in glass above at the ladies' lounge. At the top of the air well and above the ladies' lounge is a magnificent leaded glass dome.

The ladies' lounge is finished in white mahogany with an unusual amount of carving. The lower main social hall and the music room above are finished in rich mahogany, fluted pilasters terminating at the ceiling in large carved Ionic capitals. The main or grand stairway is finished in rich mahogany with graceful curves, having iron grille balustrades. The sun

FIG. 6.—LOWER SOCIAL HALL

parlor above is finished in enameled green, fluted pilasters terminating at the ceiling in Ionic capitals.

The smoking room is finished in high-grade quartered oak with softened colors. The floor of the smoking room is laid with a material known as "Compolite." Through the center of the smoking room is a glass well fitted with ornamental glass, to give ventilation and light to the social hall below.

The deck veranda is finished in teak, and is open aft for the exit of passengers to a spacious deck, over which is fitted an awning, in order that the passengers may go to and fro and enjoy the balmy air encountered on the route of this ship.

At the head of the grand stairway is a large oil painting, illustrating the Lenape tribe of Indians from which the ship's name was taken. This is a special feature heretofore unseen in any coastwise ships, the usual thing to be found at the head of a grand stairway being a plain mirror.

All the ordinary first class staterooms of this ship are

FIG. 7.—LADIES' LOUNGE

finished in white enamel with mahogany trim. The suites are elegantly finished in white ivory enamel and rich mahogany. The baths and toilets of the connecting suites contain special plumbing fixtures with running hot and cold water. The floors are laid with hexagon tile and the wainscoting of these rooms with a glazed tiling. The special rooms of the ship are likewise finished in enameled white with mahogany trim.

The first class passenger staterooms on the starboard side of the hurricane deck in the bridge enclosure are fitted with large pivot air ports, which serve to give excellent ventilation

FIG. 8.—MAIN LOUNGE

when the ship is in motion. The inside staterooms have special ventilating trunks over them, to serve both for light and ventilation.

Furnishings

The furniture in the public spaces of the *Lenape* is all portable, and equal to the best that can be found in the reception rooms of the best New York hotels. It consists of large and small-sized divans, large arm chairs and back-to-back sofas, upholstered in the richest fabrics in a variety of colors. The carpets and draperies in the Lenape's first class passenger staterooms, suites and public spaces, together with the floor

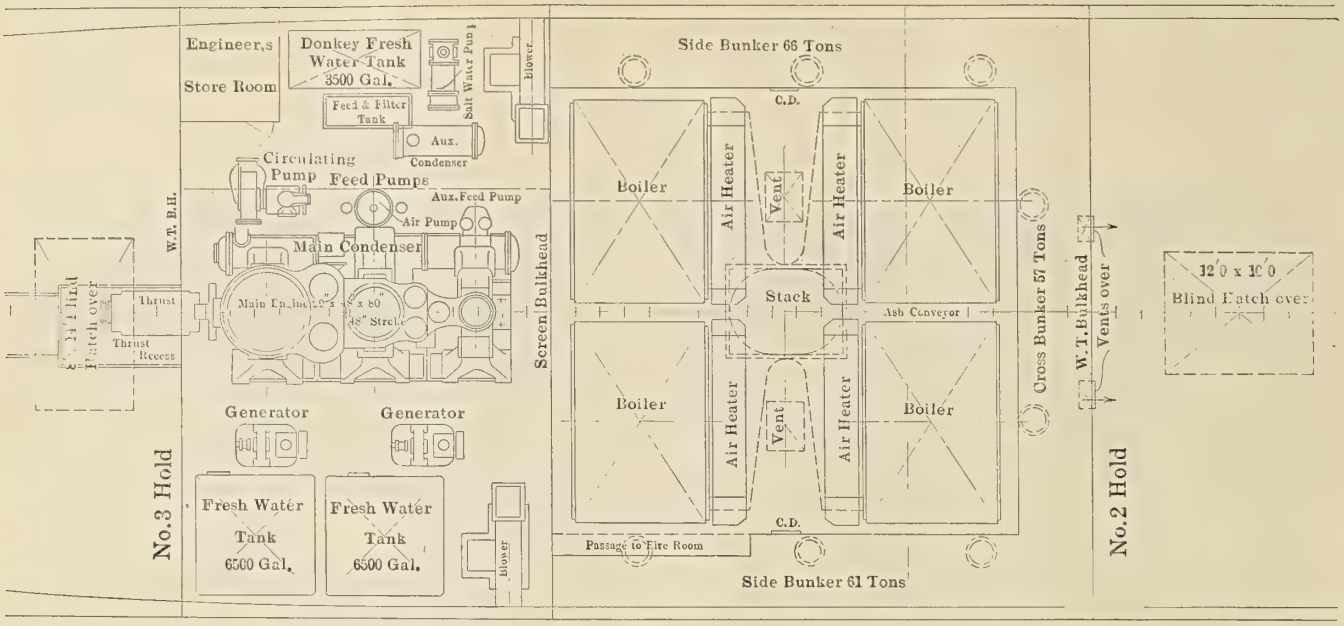


FIG. 9.—MACHINERY ARRANGEMENT

tiling, are of the best materials obtainable and of color and design to match, making the charming comforts of these public spaces all that could be desired on board ship. The ship is brilliantly lighted in every space. The electric light fixtures are of special design, neat and rich in character, hand chased and gold-plated, the fixture globes are of etched glass, all of which serves to perfect the illumination. A steam-operated vacuum cleaner is provided, by the automatic use of which everything can be kept thoroughly clean at all times.

Equipment

The life-saving equipment of the *Lenape* is modern in every particular. She has a full boat capacity for every person on board, including the passengers and crew. The fire apparatus consists of the most up-to-date appliances. There is, of course, a wireless equipment, for which two operators are maintained at all times, and a submarine bell is installed in the ship together with an electric fog whistle and all other modern appliances necessary for safe navigation.

Boilers

Steam is supplied at 190 pounds pressure per square inch by

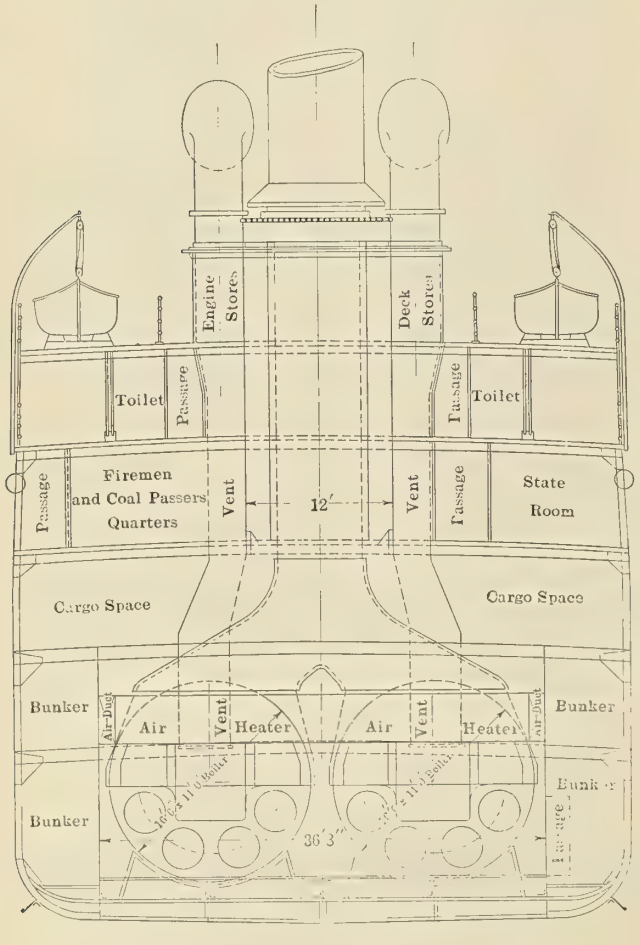


FIG. 10.—SECTION THROUGH BOILER ROOM

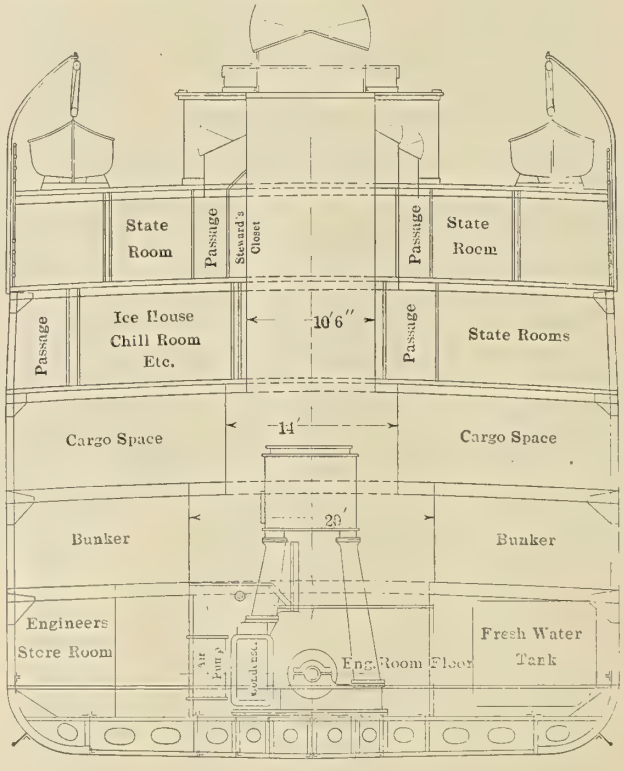


FIG. 11.—SECTION THROUGH ENGINE ROOM

four main boilers. Two of the boilers are 16 feet 6 inches in diameter, fitted with corrugated furnaces 42 inches in diameter, each boiler containing about 2,900 square feet of heating surface. The other two boilers are 14 feet 3 inches in diameter, each fitted with three corrugated furnaces 42 inches in diameter, and each containing 2,190 square feet of heating surface, giving a total heating surface for the four boilers of 10,180

Propelling Machinery

The main engine is of the three-crank, direct-acting, reciprocating, triple-expansion type, with the high-pressure cylinder 28 inches in diameter, the intermediate cylinder 47 inches in diameter, and the low-pressure cylinder 80 inches in diameter, all with a common stroke of 48 inches. The engine was designed to operate at an estimated steam pressure of 190 pounds

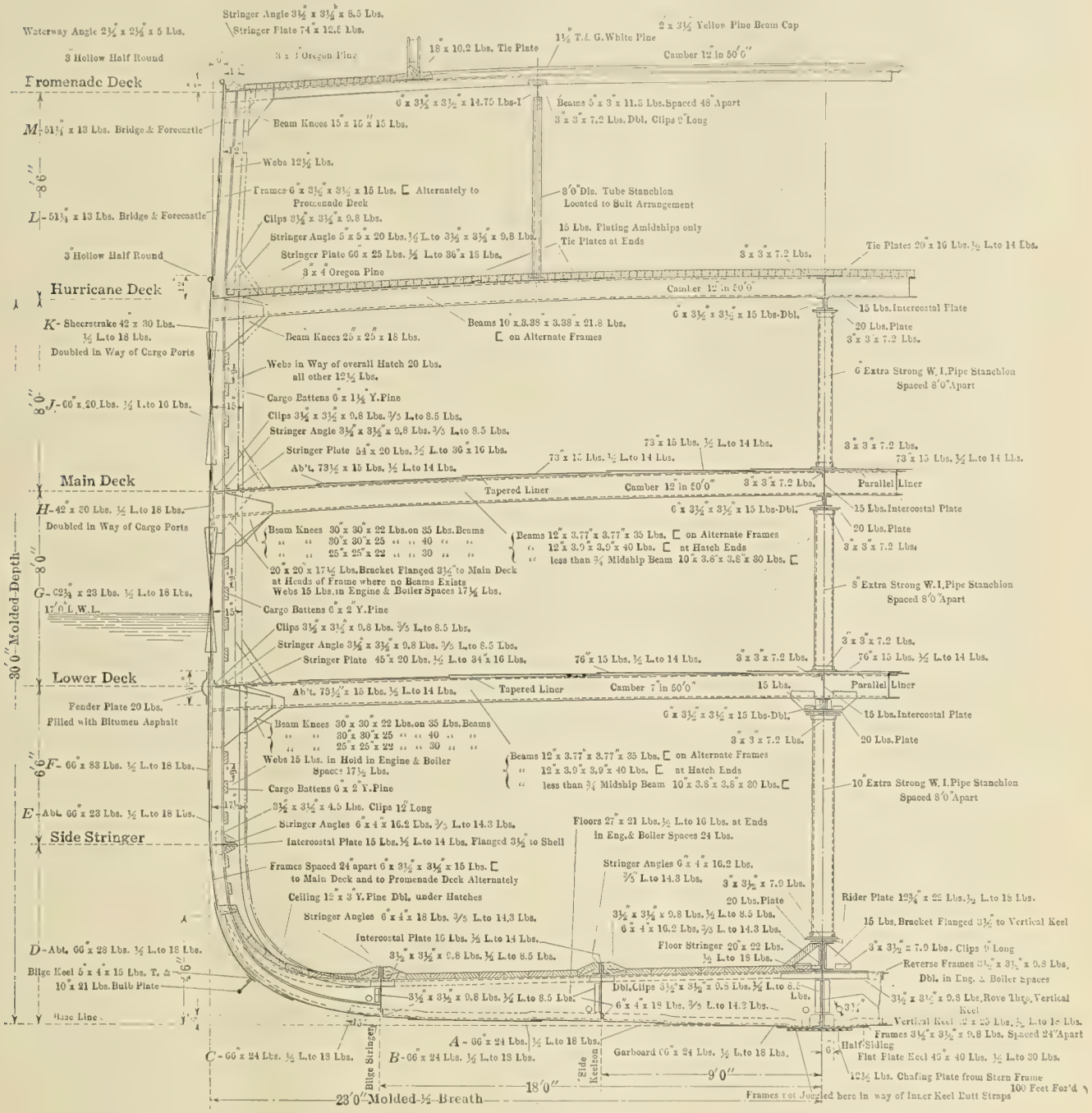

Promenade Deck
Hurricane Deck
Main Deck
Lower Deck
Side Stringer
Bilge Stringer
Side Keelson
Base Line
30'0" Molded Depth
23'0" Molded ½ Breath
18'0"
9'0"
Stringer Angle 3½" x 3½" x 8.5 Lbs.
Stringer Plate 74" x 12.5 Lbs.
Waterway Angle 2½" x 2½" x 5 Lbs.
3" Hollow Half Round
3" x 7" Oregon Pine
18" x 10.2 Lbs. Tie Plate
2" x 3½" Yellow Pine Beam Cap
1½" T. & G. White Pine
Camber 12" in 50'0"
6" x 3½" x 14.75 Lbs-I
Beams 5" x 3" x 11.3 Lbs. Spaced 48" Apart
3" x 3" x 7.2 Lbs. Dbl. Clips 9" Long
M-51½" x 13 Lbs. Bridge & Forecastle
Beam Knees 15" x 15" x 15 Lbs.
Webs 12½ Lbs.
Frames 6" x 3½" x 3½" x 15 Lbs. ⊏ Alternately to Promenade Deck
8'0" Dia. Tube Stanchion Located to Suit Arrangement
L-51½" x 13 Lbs. Bridge & Forecastle
Clips 3½" x 3½" x 9.8 Lbs.
Stringer Angle 5" x 5" x 20 Lbs. ½ L. to 3½" x 3½" x 9.8 Lbs.
15 Lbs. Plating Amidships only
Tie Plates at Ends
Stringer Plate 66" x 25 Lbs. ½ L. to 36" x 18 Lbs.
3" x 3" x 7.2 Lbs.
Tie Plates 20" x 16 Lbs. ½ L. to 14 Lbs.
3" x 4" Oregon Pine
Camber 12" in 50'0"
K-Sheerstrake 42" x 30 Lbs. ½ L. to 18 Lbs.
Doubled in Way of Cargo Ports
Beam Knees 25" x 25" x 18 Lbs.
Beams 10" x 3.38" x 3.38" x 21.8 Lbs. ⊏ on Alternate Frames
6" x 3½" x 3½" x 15 Lbs-Dbl.
15 Lbs. Intercostal Plate
20 Lbs. Plate
3" x 3" x 7.2 Lbs.
Webs in Way of overall Hatch 20 Lbs. all other 12½ Lbs.
6" Extra Strong W. I. Pipe Stanchion Spaced 8'0" Apart
J-66" x 20 Lbs. ½ L. to 16 Lbs.
Cargo Battens 6" x 1½" Y. Pine
Clips 3½" x 3½" x 9.8 Lbs. ⅗ L. to 8.5 Lbs.
Stringer Angle 3½" x 3½" x 9.8 Lbs. ⅗ L. to 8.5 Lbs.
Stringer Plate 54" x 20 Lbs. ½ L. to 36" x 16 Lbs.
Abt. 73½" x 15 Lbs. ½ L. to 14 Lbs.
73" x 15 Lbs. ½ L. to 14 Lbs.
3" x 3" x 7.2 Lbs.
Tapered Liner
Camber 12" in 50'0"
Parallel Liner
H-42" x 20 Lbs. ½ L. to 18 Lbs.
Doubled in Way of Cargo Ports
Beam Knees 30" x 30" x 22 Lbs. on 35 Lbs. Beams
" " 30" x 30" x 25 " " 40 " "
" " 25" x 25" x 22 " " 30 " "
Beams 12" x 3.77" x 3.77" x 35 Lbs. ⊏ on Alternate Frames
" 12" x 3.9" x 3.9" x 40 Lbs. ⊏ at Hatch Ends
" less than ¾ Midship Beam 10" x 3.8" x 3.8" x 30 Lbs. ⊏
20" x 20" x 17½ Lbs. Bracket Flanged 3½" to Main Deck at Heads of Frame where no Beams Exists
Webs 15 Lbs. in Engine & Boiler Spaces 17½ Lbs.
8" Extra Strong W. I. Pipe Stanchion Spaced 8'0" Apart
G-62¾" x 23 Lbs. ½ L. to 18 Lbs.
17'0" L. W. L.
Cargo Battens 6" x 2" Y. Pine
Clips 3½" x 3½" x 9.8 Lbs. ⅗ L. to 8.5 Lbs.
Stringer Angle 3½" x 3½" x 9.8 Lbs. ⅗ L. to 8.5 Lbs.
Stringer Plate 45" x 20 Lbs. ½ L. to 34" x 16 Lbs.
76" x 15 Lbs. ½ L. to 14 Lbs.
Abt. 73½" x 15 Lbs. ½ L. to 14 Lbs.
Tapered Liner
Camber 7" in 50'0"
15 Lbs.
Parallel Liner
Fender Plate 20 Lbs. Filled with Bitumen Asphalt
Beam Knees 30" x 30" x 22 Lbs. on 35 Lbs. Beams
" " 30" x 30" x 25 " " 40 " "
" " 25" x 25" x 22 " " 30 " "
Beams 12" x 3.77" x 3.77" x 35 Lbs. ⊏ on Alternate Frames
" 12" x 3.9" x 3.9" x 40 Lbs. ⊏ at Hatch Ends
" less than ¾ Midship Beam 10" x 3.8" x 3.8" x 30 Lbs. ⊏
10" Extra Strong W. I. Pipe Stanchion Spaced 8'0" Apart
F-66" x 33 Lbs. ½ L. to 18 Lbs.
Webs 15 Lbs. in Hold in Engine & Boiler Spaces 17½ Lbs.
Cargo Battens 6" x 2" Y. Pine
E-Abt. 66" x 23 Lbs. ½ L. to 18 Lbs.
3½" x 3½" x 4.5 Lbs. Clips 12" Long
Stringer Angles 6" x 4" x 16.2 Lbs. ⅗ L. to 14.3 Lbs.
Floors 27" x 21 Lbs. ½ L. to 16 Lbs. at Ends in Eng. & Boiler Spaces 24 Lbs.
Intercostal Plate 15 Lbs. ½ L. to 14 Lbs. Flanged 3½" to Shell
Frames Spaced 24" apart 6" x 3½" x 3½" x 15 Lbs. ⊏ to Main Deck and to Promenade Deck Alternately
Stringer Angles 6" x 4" x 16.2 Lbs. ⅗ L. to 14.3 Lbs.
3" x 3½" x 7.9 Lbs.
Ceiling 12" x 3" Y. Pine Dbl. under Hatches
20 Lbs. Plate
Rider Plate 12¾" x 22 Lbs. ½ L. to 18 Lbs.
Stringer Angles 6" x 4" x 18 Lbs. ⅗ L. to 14.3 Lbs.
3½" x 3½" x 9.8 Lbs. ½ L. to 8.5 Lbs.
15 Lbs. Bracket Flanged 3½" to Vertical Keel
6" x 4" x 16.2 Lbs. ⅗ L. to 14.3 Lbs.
Intercostal Plate 15 Lbs. ½ L. to 14 Lbs.
Floor Stringer 20" x 22 Lbs. ½ L. to 18 Lbs.
3" x 3½" x 7.9 Lbs. Clips 9" Long
D-Abt. 66" x 23 Lbs. ½ L. to 18 Lbs.
Bilge Keel 5" x 4" x 15 Lbs. T. & 10" x 21 Lbs. Bulb Plate
3½" x 3½" x 9.8 Lbs. ½ L. to 8.5 Lbs.
Reverse Frames 3½" x 3½" x 9.8 Lbs. Dbl. in Eng. & Boiler Spaces
Dbl. Clips 3½" x 3½" x 9.8 Lbs. ½ L. to 8.5 Lbs.
3½" x 3½" x 9.8 Lbs. Rove Thro. Vertical Keel
6" x 4" x 18 Lbs. ⅗ L. to 14.3 Lbs.
Vertical Keel 2" x 25 Lbs. ½ L. to 18 Lbs.
Frames 3½" x 3½" x 9.8 Lbs. Spaced 24" Apart
Half Siding
Flat Plate Keel 45" x 40 Lbs. ½ L. to 30 Lbs.
A-66" x 24 Lbs. ½ L. to 18 Lbs.
Garboard 66" x 24 Lbs. ½ L. to 18 Lbs.
C-66" x 24 Lbs. ½ L. to 18 Lbs.
B-66" x 24 Lbs. ½ L. to 18 Lbs.
12¾ Lbs. Chafing Plate from Stern Frame
100 Feet For'd
Frames not Joggled here in way of Inner Keel Butt Straps

FIG. 12.—MIDSHIP SECTION

square feet. The total grate surface of the four boilers is 265½ square feet. All of the boilers are fitted with Howden's system of heated forced draft, having the necessary heater tubes in the up-takes.

There is also a vertical donkey boiler located on the main deck above the fire-room. The donkey boiler is 5 feet inside diameter and 9 feet 6 inches high, containing 90 square feet of heating surface and 14½ square feet of grate surface. This boiler is of sufficient size to meet United States Steamboat Inspection Service requirements for a passenger ship.

per square inch, and develops about 3,600 indicated horsepower at 90 revolutions per minute. The high-pressure and low-pressure cylinders each have one piston valve, and the low-pressure cylinder has two piston valves. All the valve gear is of the Stephenson type with double bar links. The main air pump, the lift pump for feed, two main feed pumps and one boiler pump are driven by double beams from the low-pressure crosshead.

The main condenser is built up with the engine back framing, and is fitted with tubes ¾ inch outside diameter. In ad-

dition to the main condenser, which contains about 6,000 square feet of cooling surface, there is an auxiliary condensing plant of about 750 square feet of cooling surface, fitted with ¾ inch outside diameter tubes. The auxiliary condenser is mounted on a horizontal combined air and circulating pump, 10 inches by 12 inches by 12 inches by 12 inches.

The main circulating pump is of the centrifugal type, with cast iron casing and brass impeller and shaft. The impeller is 42 inches diameter. The pump has 16 inches diameter suction and discharge connections and is driven by an 8 by 10-inch independent engine.

The main engine is fitted with a complete and convenient system for water-cooling the crosshead guides, crankpins, main bearings, thrust bearings and spring bearings, the water being supplied by the sanitary pump. In the engine room are fitted a revolution counter, clock, steam and vacuum gages, and engine telegraph of the reply type, Corey make, also voice pipes and mechanical telegraph for quick communication between the engine and boiler rooms, all suitably arranged. There are also fitted in the engine room the neccessary oil tanks and waste tanks, and at the after engine room bulkhead is an engineers' storeroom and workshop, while the various machinery spare parts are stowed about the engine room.

The main engine crankshaft, together with the thrust shafting, line shafting and propeller shaft, is of high-grade forged steel. The propeller is of the four-blade solid type, of manganese bronze, having a diameter of 15 feet and a pitch of 18 feet 3 inches.

Auxiliaries

Independent Pumps—Besides the independent pumps already mentioned in connection with the propelling machinery there is an auxiliary feed pump of the vertical duplex type, 12 inches by 8½ by 10 inches; one horizontal duplex water pump 6 inches by 4 inches by 6 inches, and one vertical duplex sanitary and water service pump, 12 inches by 12 inches by 10 inches, all of the Worthington make. There is also one main injector and one donkey injector.

Feed-Water Heater—A feed-water heater of the Blake vapor type is locted in the engine hatch. A feed and filter tank of rectangular shape, made of iron, is provided.

Piping—The main auxiliary steam pipes are of copper with brass flanges brazed on. There is one side main injection and one lower main injection. The steam lines for the auxiliary machinery are fitted with Leslie's reducing valves where necessary.

Generators—Current for electric lighting in the passenger quarters and cargo spaces is supplied by two General Electric direct-connected generators, one of 35-kilowatt and the other of 15-kilowatt capacity, located in the engine room.

Water Tanks—In the main engine room there are installed fresh water tanks for culinary use, having a total capacity of 12,700 gallons.

Refrigerating Machinery—The refrigerating apparatus consists of one Brunswick ice machine, having a capacity of 3 tons per hour.

Forced Draft Fans—There are two Sturtevant forced draft fans placed in the main engine room to supply heated forced draft for the main boilers.

Deck Pumps—Deck pumps are provided to meet the United States Steamboat Inspection Service requirements, one placed forward and one aft in the ship.

Steam Heating System—There is a complete steam heating system throughout all living quarters of the ship. It is of the return system, in circuits, and so arranged that the heat can be controlled independently in the passenger staterooms and public spaces, passageways and alcoves. Pipe leads of special pattern are fitted in the staterooms so as to be concealed from the passenger's view.

Cargo Hoist Winches—There is fitted at Nos. 1, 2, 3, 4 and 5 hatches, one double-cylinder, double-drum spur geared 8-inch by 8-inch cylinder steam hoister, and on the lower deck at hatch No. 4 a single-cylinder, spur geared, 8-inch by 8-inch steam hoister. All cargo winches are of the Williamson make. At Nos. 2, 3, 4 and 5 cargo hatches cargo swinging cranes are fitted, one on each side of the hatch.

Steam Steering Gear—The steam steering gear, made by the American Engine Company, consists of an 8-inch by 8-inch by 7-inch steam steering engine with drum, placed in the main engine room. There is also a hand-steering gear with leads to the steam steering gear. The steering engine is controlled from the pilot house by a hand-wheel and shafting to the steering engine.

Aft on the hurricane deck is an auxiliary hand-steering gear of the right and left-hand screw type, to be used in case of breakdown of the steam steering gear or the combined hand and steam gear from the pilot house.

Steam Windlass—The steam windlass, located in the forecastle head, is of ample size to handle the anchors and chain cables. It is of the pump brake type built by the Hyde Windlass Company, Bath, Me.

Steam Capstans—Actuated from the steam windlass placed on the forecastle head is a steam capstan 18 inches in diameter, also aft on the hurricane deck there is a steam capstan 18 inches in diameter operated by a vertical shaft from a capstan engine located in the cockpit below. Both capstans are of the Hyde make.

Performance of the Ship

The *Lenape* was designed for a service speed of 14 knots, her route being between New York, Charleston and Jacksonville and return. On her maiden voyage, which began on Jan. 22, 1913, the run from Scotland Lightship to Charleston Bar was made at an average speed of 15¼ knots, or 1¼ knots above her designed speed, which is a record for the Clyde Line. This was accomplished on a remarkably low coal consumption. On recent voyages the *Lenape* demonstrated excellent sea-going qualities in a moderate hurricane off Cape Hatteras, making excellent headway in heavy head weather, winning the admiration of her captain and officers and of the passengers.

William Froude National Tank.—The William Froude National Tank, established in connection with the National Physical Laboratory at Teddington through the munificence of Mr. A. F. Yarrow, is now in full working order and completely equipped to undertake the testing of ship models. This tank was intended primarily for research work in problems connected with ship propulsion, but it also undertakes model tests for private firms and individuals. The income of the tank depends partly upon fees charged for test work and partly upon the support of the leading shipbuilders and shipowning firms who have guaranteed an aggregate sum of $6,325 (£1,300) for several years to come. The annual expenditure on staff maintenance and operation of the tank is, however, estimated at about $12,180 (£2,500), and as it is desired to make a special feature of systematic research work, some of the results of which will be published in the transactions of the Institution of Naval Architects, it will not be possible to obtain from fees the balance of income required. Subscriptions are, therefore, sought from the shipowning and shipbuilding firms who are not already on the list of subscribers in order to bring the guaranteed sum for maintenance up to the required amount, so that the important work undertaken by the tank can be carried out without hindrance.

United States Naval Appropriations.—The bill for naval appropriations passed by the Sixty-second Congress provides for the construction of one first-class battleship carrying as heavy armor and as powerful armament as any vessel of its class, to have the highest practicable speed and greatest desirable radius of action and to be built in a Government navy yard; six torpedo boat destroyers, to have the highest practicable speed; four submarine torpedo boats; one transport and one supply ship.

Fast Turbine-Driven Yacht Winchester

Among the noteworthy additions to the fleet of the New York Yacht Club last year was the turbine-driven steam yacht *Winchester*, designed by Messrs. Cox & Stevens, of New York, for Mr. Peter Winchester Rouss, and built by Messrs. Yarrow & Company, of Scotstoun. The vessel is 205 feet in length, with a beam of 18 feet 6 inches, the hull being of steel and in design very similar to the recent torpedo boat destroyers, having a high raised forecastle associated with extreme flare of the forward sections, thus producing the best possible seagoing hull for a high-speed boat.

The vessel is flush-decked throughout, with a large dining room on the forward deck, the top of which is at the same level as the forecastle deck. There are two large funnels, one military mast and a large after-deck house, containing the companion stairs to the owner's quarters, which are located below aft. These quarters comprise a large, handsome saloon and the owner's room, extending the full width of the vessel, a large bath room with dressing room attached, and also two comfortable single staterooms and one large double stateroom with two baths.

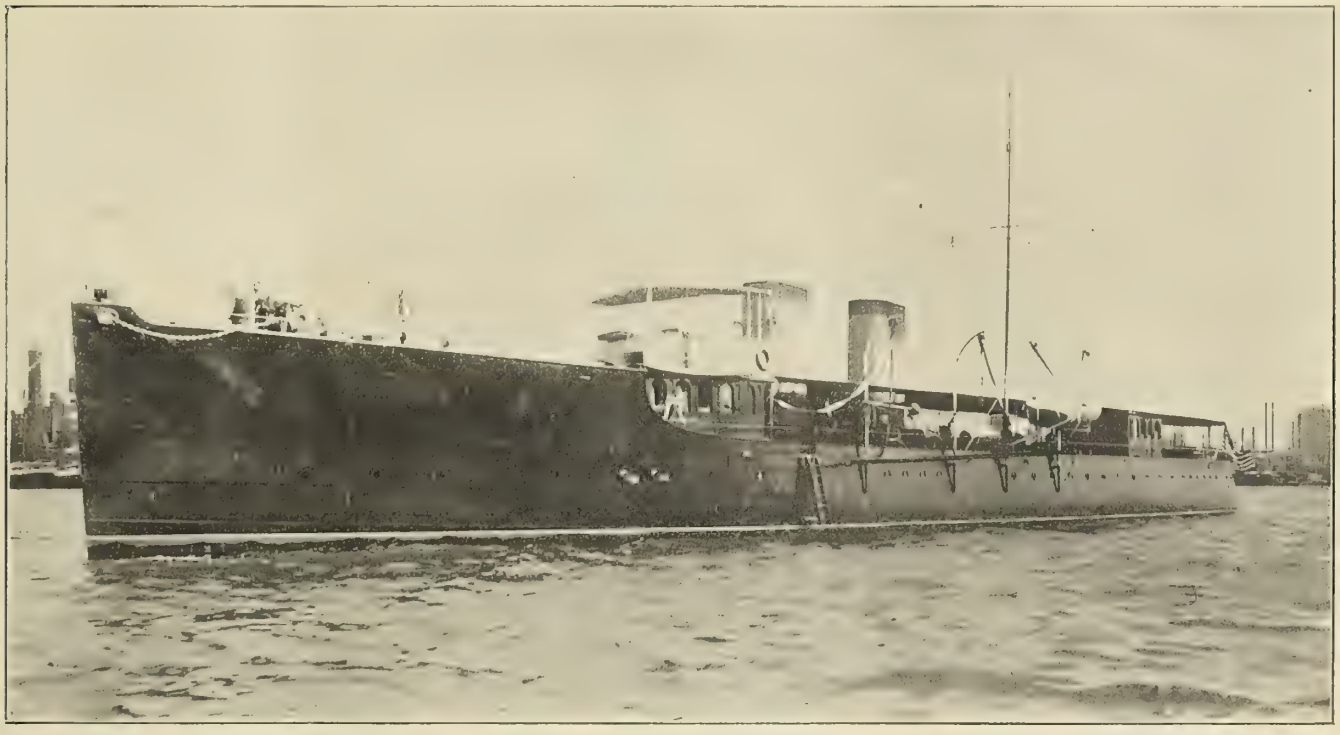


FIG. 1.—THE NEW WINCHESTER

The *Winchester's* machinery installation consists of Parsons turbines, driving twin screws, the total shaft-horsepower being approximately 6,000, steam being supplied by two oil-fired watertube boilers of the Yarrow type. The high-pressure turbine drives the port propeller and the low-pressure turbine the starboard propeller, an astern turbine being incorporated in the low-pressure casing.

Although the contract speed of 32 knots for which the *Winchester* was designed was considered unusually high, yet it is interesting to note that this speed is attained with a steam pressure of 165 pounds per square inch, whereas the boiler pressure allowed is 260 pounds, so that the vessel is capable of much more than her contract speed. In fact, a speed of 34 knots has already been obtained. On a preliminary trial over a measured mile with a steam pressure of 240 pounds at the boiler and 195 pounds at the high-pressure turbine, with a vacuum of 27¾ inches and an air pressure in the stokehold of 5 inches of water, a mean speed of 32.237 knots was obtained at 1188.6 mean revolutions per minute of the propellers.

While the figures for speed are remarkable, another feature that will be appreciated by yachtsmen is the fact that while running at high speed there is an absolute absence of vibration in the boat, and she moves through the water without creating any appreciable disturbance, so far as can be seen from the boat itself, the wake being perfectly flat and the diverging wave system being scarcely noticeable. Practically the only indication of high speed when on board, except for the swift passage of the water by the boat, is the thin and high bow wave which is turned down by the flaring sides, so that even in a cross wind with a choppy sea water and spray are prevented from coming on deck.

Besides the features already mentioned, the *Winchester* makes a very good showing as far as economy of operation is concerned. Her entire crew consists of only fourteen men, whereas the average engine room force alone in an ordinary steam yacht of her length, having a speed in the neighborhood of 21 or 22 knots, with about the same accommodation, using reciprocating engines and coal-fired boilers, is greater than the total crew of the *Winchester*. In addition to the saving in crew expenses, the consumption of fuel at cruising speeds proves very economical in spite of the fact that the vessel is heavily powered and designed for high speeds. During a recent trip from Halifax to New York she averaged better than 18 knots with no fire under one boiler and only one-half of the burners under the other boiler in operation, thus utilizing practically one-quarter of her total boiler power. Under these conditions her fuel consumption per mile is extraordinarily low, even as compared to the most economical reciprocating engine and coal-fired boiler installations, the total amount of fuel consumed for the voyage being 25 tons.

Oil fuel associated with turbine engines has for some time been the only combination considered by the navies of the

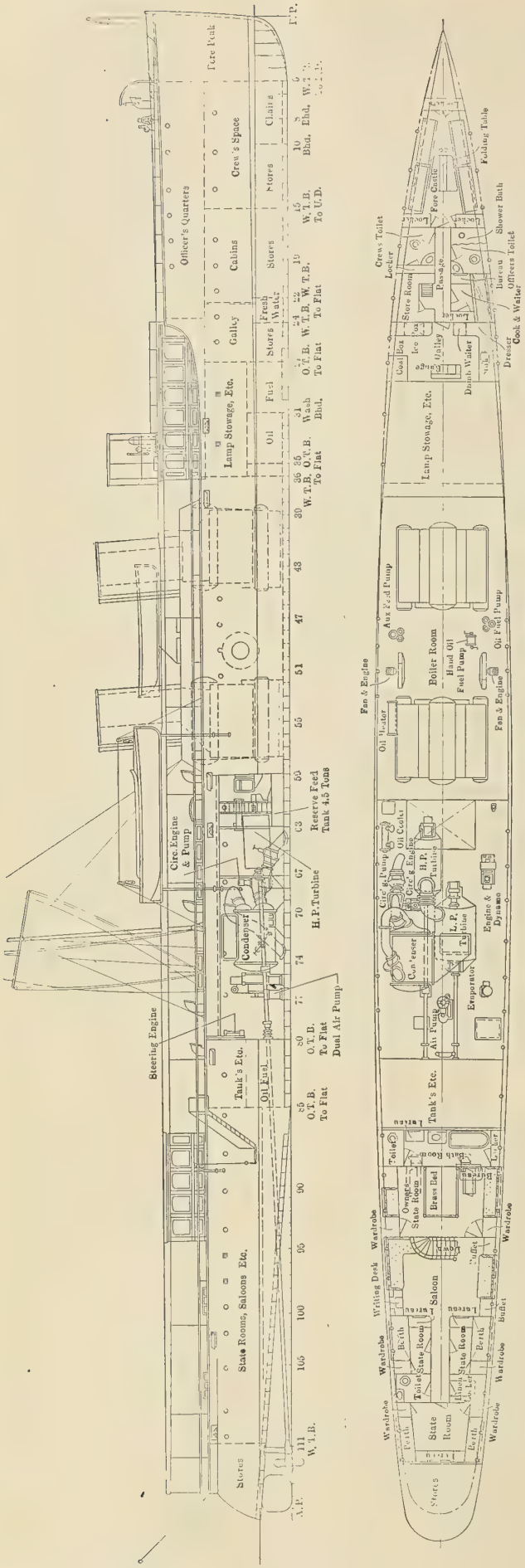


FIG. 2.—PROFILE AND DECK PLAN OF THE WINCHESTER

world for high-speed torpedo boats and destroyers, but until Mr. Rouss ordered the preceding *Winchester* from Messrs. Cox & Stevens this combination had not been successfully tried by yachtsmen. The complete success of the preceding *Winchester* (now the *Flying Fox*) led Mr. Rouss to commission the same architects to secure for him a larger and faster vessel having the same engineering features, resulting in the design and construction, with such excellent results, of the new *Winchester*.

A Motor-Driven Freight Ship

BY OUR BERLIN CORRESPONDENT

A freight ship driven by a crude oil motor has been recently built at Messrs. Fritz Bettin's Soelne's shipyards, at Tangermuende, Germany. The following are the main data of this vessel, which is remarkable in several respects:

Length over all..... 132 feet 8 inches.
Maximum breadth..... 15 feet 2 inches.
Minimum height at sides..... 8 feet.

The capacity of the *Bromberg*, as the vessel is called, is

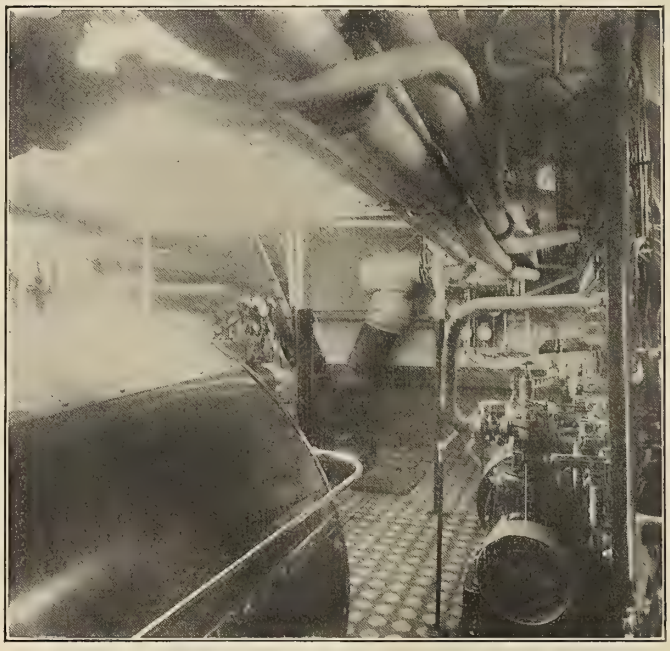


FIG. 3.—LOOKING FORWARD IN THE WINCHESTER'S ENGINE ROOM

197 tons, whereas that of a steamer of equal dimensions would be only 170 tons.

The 80 horsepower crude-oil motor, running at a speed of 325 revolutions per minute, has been designed by Messrs. Bolinders, of Stockholm. Its fuel consumption for each horsepower hour with full load is 250 grams of ordinary crude oil, as available at a low price in all ports of the world. It is a two-cycle reversible motor, imparting to the vessel with its full load a speed of 6 knots against the tide, with the average water level of the River Elbe.

The vessel contains the following compartments: In the rear, a compartment for all sorts of accessories, next to this a motor compartment with lateral fuel tanks followed by a rear hold, a captain's cabin in the center, and two holds, one of which is contiguous with the crew's cabin.

The bottom and sides are of shipbuilding steel, the former being riveted. There are two intercostal keelsons and hatches covered with corrugated sheet iron. The pilot's stand is behind the motor compartment, and there are two hoists and capstans.

FIG. 4.—OWNER'S STATEROOM ON THE WINCHESTER

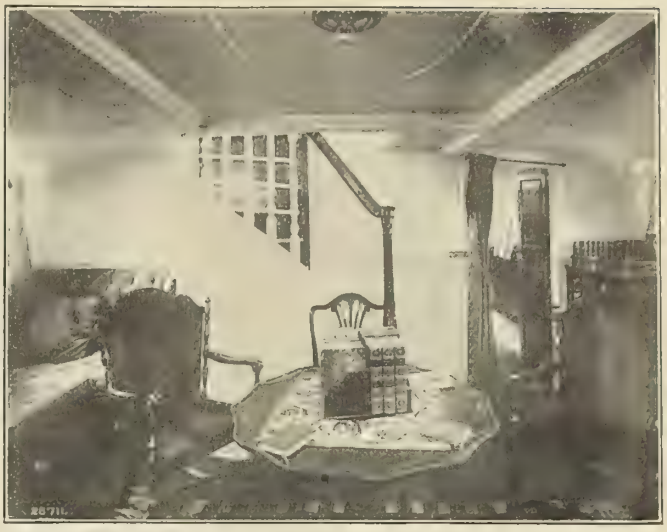


FIG. 6.—MAIN SALOON ON THE WINCHESTER

The following are the main advantages of motor-driven vessels of this type over freight steamers:

A reduction in the draft and increase in capacity and in the volume of the holds, absence of any stoker, permanent readiness for operation, absence of any dust as produced in coaling and in firing the boiler, absence of any boiler cleaning and overhauling, and finally the possibility of controlling the speed and reversing the motor by acting on a lever at the pilot's stand. Besides the reduction in crew's expenses and the increase in carrying capacity there is a saving in fuel consumption.

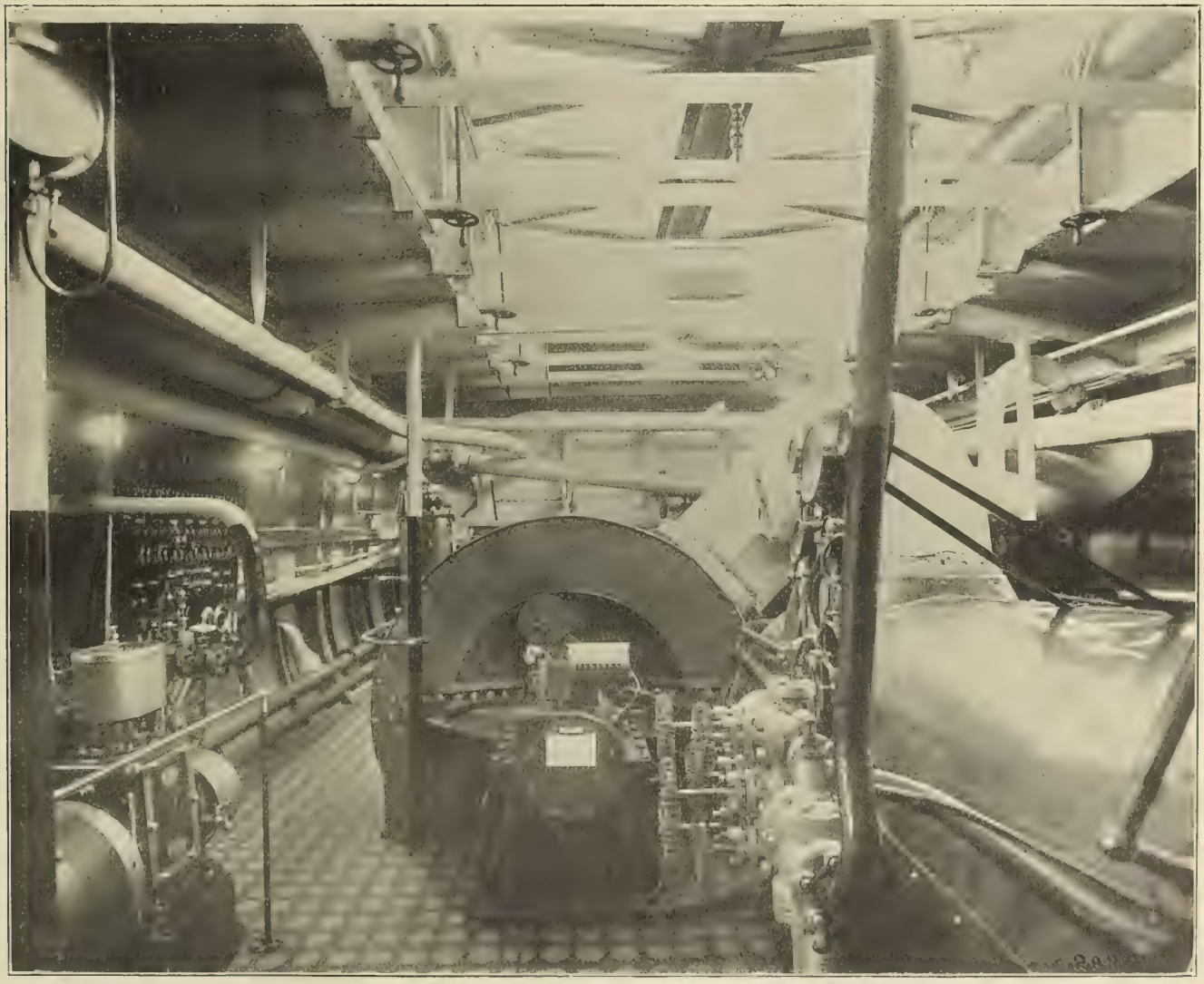


FIG. 5.—VIEW OF THE WINCHESTER'S ENGINE ROOM, LOOKING AFT

Relaunching a Vessel on the River Clyde

BY GEORGE K. TURNBULL

The immense tonnage navigating the Clyde from Glasgow to the sea is by no means immune from accident, but seldom, if ever before in the history of the river, has a vessel been stranded in a field 20 feet from the river bank, as happened recently within 3 miles of Glasgow Bridge. The story of the stranding and subsequent relaunching of this vessel is of sufficient interest to record, especially as the salvage procedure would be somewhat similar in connection with any size of ship so situated.

The vessel referred to, the steamship *Carnalea*, was built by Messrs. Scott & Sons, Bowling, her dimensions being 178 feet 6 inches between perpendiculars by 28 feet beam by 13 feet molded depth. She was launched Nov. 26, 1912. A gale of wind, from about southwest, had been blowing throughout the previous night, and the morning of the 26th broke with little change in the weather conditions. The prospects of any launch taking place were not hopeful; in fact, some builders who had launches arranged for that day decided to postpone them till better conditions prevailed. A lull of the wind, however, induced Messrs. Scott to carry through their arrangements, and the launch was safely accomplished. The vessel was then taken in charge by two tugs and proceeded to Glasgow harbor, with the object of having the engines and boilers put on board and the fitting out completed.

Good progress was made up the river to a point midway between the shipyards of Messrs. Chas. Connell & Company and Messrs. Ritchie, Graham & Milne, where the tugs could not keep control of the vessel and she went ashore on the north bank. The tide by this time had risen to a most exceptional height, and the vessel, which drew 6 feet aft and 5 feet 6 inches forward, was carried over the bank and took the ground, the after end being 20 feet from the top of the river bank, and the forward end projecting over the bank about 5 feet, as shown in position 1, Fig. 1.

The ahead tug also went ashore and grounded on the sloping bank, which is here heavily ballasted with stone pitching. The precarious position of the stranded tug as she hung on the bank is shown in Fig. 2.

The work of taking off the tug was put in the hands of Messrs. Barclay, Curle & Company, under the supervision of Mr. Hugh Martin, of Glasgow, and Mr. Main, of Leith, for the insurance association concerned; the relaunching of the *Carnalea* was entrusted to Messrs. D. & W. Henderson & Company, Ltd., acting under the instructions of Capt. Robertson, on behalf of the London Salvage Association, and J. B. Cousins, Glasgow, underwriters' surveyor.

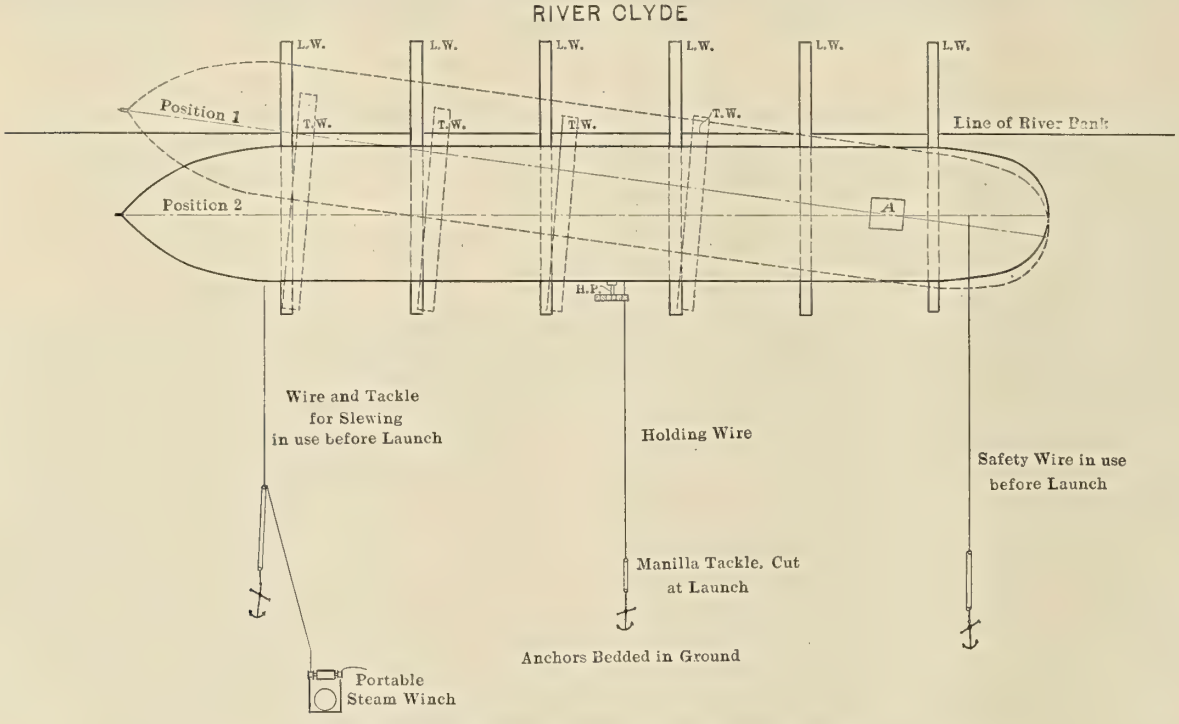


FIG. 1.—DIAGRAM SHOWING POSITION OF THE STRANDED VESSEL
T. W. are the temportry ways; L. W. are the launching ways, and H. P. is a hydraulic pump.

As a rule, when a vessel goes ashore even at high water it is possible to lighten her sufficiently to float her off at some subsequent high tide by discharging cargo, bunkers or ballast. In the case of the *Carnalea*, however, she was a newly launched ship and could not be appreciably lightened, and moreover she was situated about 2 feet above H. W. O. S. It was agreed from the first survey of the position that she would have to be relaunched.

Had it been possible to lay the launching ways far enough out into the river the vessel might have been launched directly from the diagonal position in which she lay, but as the formation of the river bank precluded this the first operation was to move the vessel around parallel to the river bank. This was accomplished by first digging troughs in the ground below the forward part of the vessel and laying in temporary ways and making her pivot upon a solid block, shown at *A*, Fig. 1, 20 feet from the stern post about which she slewed. The ground on the port side was removed from the point *A* forward as required. A wire tackle was attached to the fore part of the vessel and coupled to a treble wire purchase, the hauling part of which was led to a portable steam winch. When the weight of the vessel was taken on the timber logs she had a list

of 2 degrees to starboard, but she was brought upright by wires and tackles before being blocked up for slewing into the required position. When this operation had been performed the vessel was parallel to the river at a distance of about 17 feet 6 inches from it, as shown in position 2, Fig. 1.

Six troughs were then cut and the final launching ways placed in position. Fig. 3 shows the transverse arrangement of the ways, and also shows the extent of the digging which required to be done on the river bank, over 10,000 cubic feet of earth and stonework being dealt with. The ways were set to a declivity of 1 in 12, and supported at the outer end as

FIG. 2.—TUGBOAT ON THE RIVER BANK

shown. The weight of the vessel was 420 tons, and the mean pressure on the ways about 1 ton per square foot. No dog shores were fitted, the vessel being held in place previously to launching by a wire passed right round the ship amidships and set up to a manila tackle, provision being made on board for speedily clearing the wire after launching. The vessel was released by the severing of the manila tackle, an hydraulic pump being fitted amidships to start the vessel if required.

The *Carnalea* was successfully relaunched Dec. 27 in the presence of a number of interested spectators and amid the hearty cheers of the workmen who had carried out this

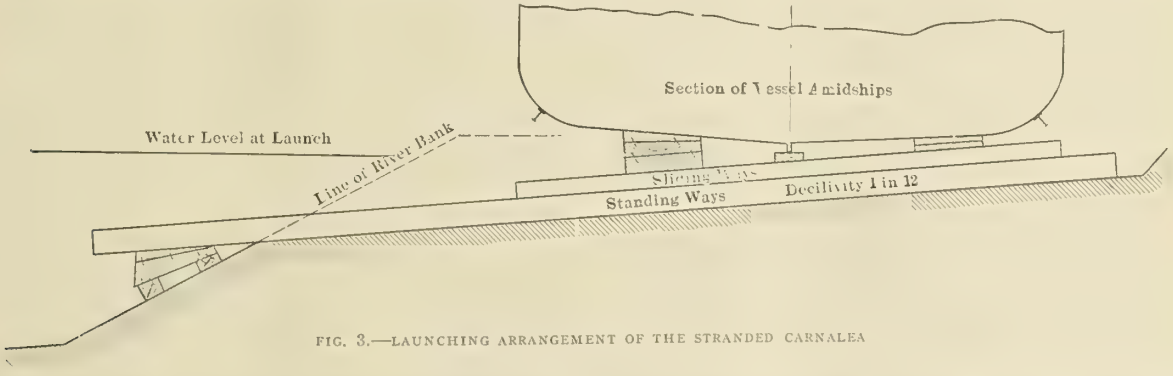


FIG. 3.—LAUNCHING ARRANGEMENT OF THE STRANDED CARNALEA

unusual piece of work. The time occupied in carrying out the complete operations from Dec. 3, when Messrs. Henderson received instructions to proceed with the work, was 21 working days. The weather during most of that time was extremely boisterous and wet, and much of the work which could only be done at low water had to be regulated to suit the tides. Considering these adverse circumstances, the time occupied and the thorough manner in which the whole operation was carried out and brought to a successful conclusion, reflect great credit on all concerned. The *Carnalea* was subsequently docked for examination, and it was found that she had sustained no damage from her unusual experience.

Westinghouse Leblanc Refrigerating System

Ammonia, carbon or sulphur dioxide, and dense air refrigerating machines are familiar to most marine engineers. There is, however, a certain range of temperature within which an even more familiar medium—water vapor—produces the desired cooling results, and, it is claimed, at a lower cost in power or higher efficiency. At the same time it is free from the difficulties attendant upon the other systems, such as the use of active chemicals and the maintenance of heavy reciprocating apparatus which are necessarily productive of difficulties in continued operation.

FIG. 4.—THE CARNALEA STRANDED BESIDE THE RIVER

The range of temperature referred to is between the approximate limits of 35 to 50 degrees F., and it is for the production of such temperatures, by the evaporation of water or brine solution, that the Westinghouse Leblanc refrigerating apparatus, manufactured by the Westinghouse Machine Company, Pittsburg, Pa., is peculiarly adapted.

The largest application for this system so far has been in connection with magazine cooling on vessels of the French navy, about thirty of which are so equipped at the present time. Fig. 1 shows the apparatus as installed on the French battleship *Danton*. This is a 10-ton machine, and is remarkable for its small dimensions, the length being 110 inches, width 63 inches, and height 71 inches. The complete weight is 5,500 pounds and the power required less than 10 kilowatts.

The principle of operation will be apparent from the diagram, Fig. 2. The water, or brine, to be cooled enters the top of the evaporator, and passes through the spraying plate, where the nozzles divide it into fine mist, in which condition it reaches the body of the evaporator vessel. This region, as will be seen later, is maintained at a very high vacuum, about 29.8 inches of mercury (one-tenth pound absolute pressure), which corresponds to a boiling temperature of about 34 degrees F. for either brine or water. The liquid, therefore, tends to

vaporize, but since there is no heat supplied to effect this, the liquid gives up its own sensible heat until it is cooled to the temperature corresponding to the absolute pressure in the vessel. If, for instance, the brine enters the evaporator at 44 degrees F., each pound would fall 10 degrees in temperature, releasing 10 British thermal units, in cooling to the temperature of the vessel pressure, 34 degrees. Since the latent heat of

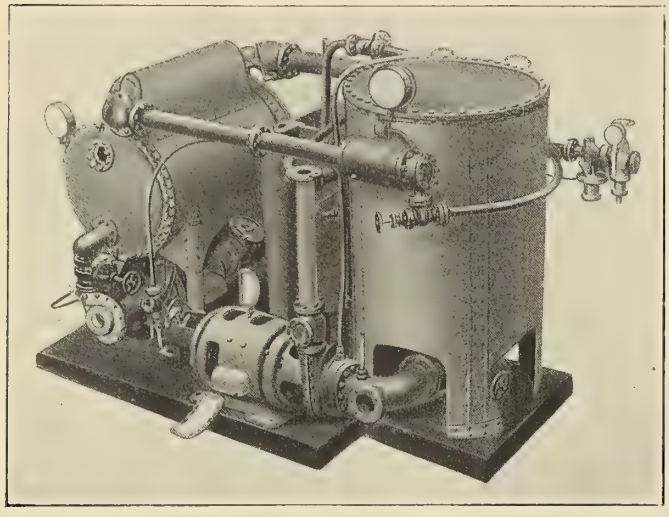


FIG. 1.—10-TON WESTINGHOUSE LEBLANC AIR COMPRESSOR

vaporization of 1 pound of brine or water at .2 inch of mercury is 1,090 British thermal units, the vaporization of 1 pound of brine will result in a 10-degree drop in temperature of $\frac{1,090}{10} = 109$ pounds. This large ratio accounts for the desirability of water vapor as a cooling medium, the heat-absorb-

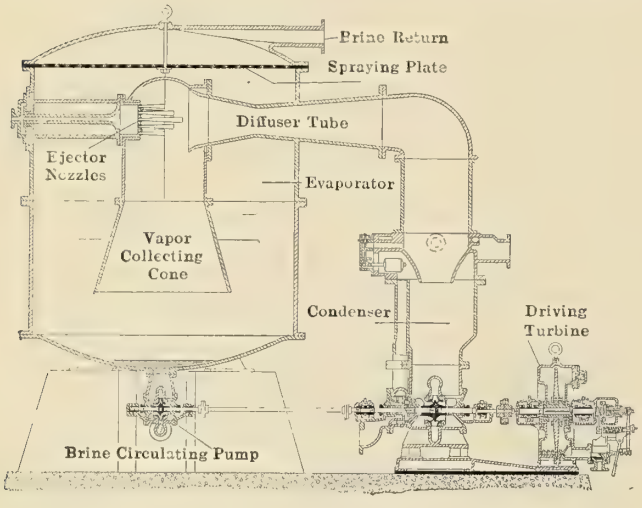


FIG. 2.—DIAGRAM SHOWING ARRANGEMENT OF AIR COMPRESSOR

ing capacity of a substance being a measure of the cooling effect obtainable.

The function of the vapor-collecting cone, ejector and condenser will now be apparent. In order to maintain the low pressure necessary in the evaporator the vapor coming off from the brine must be removed. A vacuum of 28.8 inches may be readily obtained by passing these vapors out through the collecting cone to a condenser supplied with 70-degree water. Since a vacuum 1 inch higher than this, or 29.8 inches, is desired, the steam ejector is employed, producing the additional inch by entraining the vapor and carrying it through the diffuser toward the condenser. The steam for the ejector may be supplied from the boiler plant, or any exhaust steam available may be used. In general, the amount required is about twice that formed by the vaporization of the brine. The condenser proportions must, of course, be such as to condense the total amount involved to a vacuum within about 1 inch of that required in the evaporator proper.

The structural simplicity of the system is apparent. The condenser, of the familiar Westinghouse Leblanc jet type, employs rotating pumps for the removal of the air as well as the circulating water and condensed steam. The extension of the shaft so that it will also drive the brine circulating pump makes a compact and relatively light outfit which has no wearing surfaces except those of the shaft journals. Although a non-condensing turbine is the generally advisable form of drive, a motor may be employed if desired. The system in which the brine circulates is closed with the exception that, due to the loss of water in the evaporator, a small amount must be added to maintain the proper dilution. This is preferably done just before the return to the spraying nozzles.

Institution of Naval Architects

At the annual meeting of the Institution of Naval Architects, held in the hall of the Royal Society of Arts, John street, Adelphi, on March 12, 13 and 14, the following papers were read and discussed:

March 12

1. Recent Developments in Battleship Type. By Alan H. Burgoyne, M. P.

2. The Influence of Air Pumps on the Military Efficiency of Turbine-Engined Warships. By D. B. Morison.

March 13

3. Mechanical Gearing for the Propulsion of Ships. By the Hon. Sir Charles A. Parsons, K. C. B., D. Sc., F. R. S.

4. Compressed Air for Working Auxiliaries in Ships Propelled by Internal-Combustion Engines. By W. Reavell.

5. The Energy Systems Accompanying the Motion of Bodies Through Air and Water. By Prof. J. B. Henderson, D. Sc.

6. The Calculation of Stability in Non-Intact Conditions. By Professor W. S. Abell.

7. Notes on Modern Airship Construction. By Baron A. Roenne.

8. The Longitudinal Stability of Skimmers and Hydro-aeroplanes. By J. E. Steele, B. Sc.

March 14

9. On Large Deck Houses. By J. Foster King.

10. Methodical Experiments with Mercantile Ship Forms. By G. S. Baker.

11. Launching Declivities for Ships and Their Influence Upon Poppet and Way-End Pressures. By A. Hiley.

12. Stresses in Stayed Cylindrical Shells. By C. E. Stromeyer.

13. The Distribution of Stress Due to a Rivet in a Plate. By Prof. E. G. Coker, M. A., D. Sc., and W. A. Scoble, B. Sc., Wh. Sc.

14. Stresses in a Plate Due to the Presence of Cracks and Sharp Corners. By C. E. Inglis, M. A.

The annual dinner of the Institution was held on Wednesday, March 12, in the Grand Hall of the Connaught Rooms.

International Exhibition.—It has been proposed to hold an International Exhibition in Glasgow either in 1915 or 1916 to be devoted primarily to engineering and shipbuilding if a suitable site can be granted by the corporation. Sir A. McInnes Shaw, late Lord Provost, is chairman of the Provisional Committee, and the movement is supported by leading shipbuilders and engineers in the city.

Preservation of Metals for Marine Work*

BY LIEUT.-COM. FRANK LYON, U. S. N.

In taking the above title for this paper the writer intends to apply to vessels only under the two sub-divisions:

The metal of the hull.

The metals of the engines, boilers and machinery accessories.

The causes of the wasting away of such metals are three:

1. Corrosion.
2. Abrasion.
3. Erosion.

Corrosion is the most serious of the three, is ever present, and is the most difficult to combat.

Metals are weakened by all of the three causes and also by the continued variation of stresses in them. These variations tend to open up and emphasize the inherent defects in the metals due to segregation of the impurities in them and to their different physical characteristics which are induced or produced by the different temperatures at which they are worked during stages up to and including the finished article.

Corrosion, the chemical decomposition of metal, is due to the differences in electric potential between the metal and the liquid or moisture that wets its surface. It is produced only when the metal is wet or moistened by some liquid of lower potential than metal itself. Metals that are absolutely dry do not corrode, and wet metals corrode only on their wetted surfaces.

In this paper it is assumed that there is some definite, absolute zero of electrical potential similar to the absolute zero heat, and that all bodies and liquids have some definite potential at each temperature. When a metal at a certain potential is immersed in a liquid of lower potential the metal dissolves with the liquid and raises its potential; if the metal remains in solution in the liquid until the potential of the liquid solution is the same as that of metal, the solution is then saturated and no further dissolving takes place until the conditions of temperature or liquid solution are changed. If the potential of the liquid is the higher, the liquid exerts an electrical pressure on the metal but does not cause it to dissolve. If the metal can dissolve in the liquid, but is thrown out of solution as rust by some chemical agent inherent in either the metal or liquid, the dissolved parts do not raise the potential of the solution and the dissolving goes on to the extinction of the metal. The same results will be attained if the liquid is changed as fast as the metal dissolves into it, such as a plate on the side of a ship in a large body of water.

The diffusion of the dissolved parts of any substance in a liquid is believed to be due to the fact that the potential of the liquid is raised at the dissolving point, and that the tendency of all parts of any liquid body at different potentials is to equalize or come to a common potential. This in itself tends to keep the potential of the liquid at the dissolving point down until the potential of the whole body of the liquid is brought to the same as that of the dissolving substance. That is, the liquid becomes a homogeneous solution throughout its whole mass by diffusion of the dissolved parts into the solvent. If a metal has all of the points in its wetted surface at the same potential, and that potential is higher than that of the liquid by which wetted, it will corrode or dissolve at all of its points and general corrosion is said to exist. If the potentials of some of the points are higher and others lower than that of the liquid in which it is immersed, it will corrode only at the points where its potential is higher than that of the liquid, and local corrosion is said to exist with pitting of the metal as a result. The potentials of pure metals and liquids vary with their temperatures and with the way in which they are stressed, and those of impure metals and solutions vary in the same way, and also with the way in which the ingredients vary with the temperatures. That is, an alloy would not have the same potential that any one of its ingredients would have at the same temperature, but one common to that of all of the ingredients. Also, the potential of a solution at any temperature would not be the same as that of either the liquid or dissolved substance at that temperature, but at some one potential common to them both. In other words, the theory of potentials is assumed to be similar to the theory of heat. If two bodies—solid, liquid or gaseous—at different temperatures are brought near each other they assume a common temperature in proportion to the amounts of heat each contains, and it is easily conceivable that the same objects at different electrical potentials would come to some common potential in proportion to some inherent qualities of the two bodies in question.

If two metals are connected by a metal conductor and they are immersed in a liquid, and if one of them is at a potential higher than the liquid and the other at a lower one than the liquid, the higher one dissolves into the liquid and raises its potential, the liquid discharges its potential to the one lower than itself, and a current flows and the original condition is maintained. If the metal connection is broken, then the metal of higher potential raises that of the liquid, which in turn raises that of the metal of the lower potential, and eventually the potential of the whole becomes equal to that of the higher metal, no current flows, the original condition is destroyed, and the metal-water-metal series is polarized. A metal with different potentials at points in its surface immersed in water or a water solution acts in the same way. If all of the points are higher than that of the solution they all corrode until the potential of the liquid is raised to that of the lowest point on the metal. As the points of higher potential dissolve into the liquid and tend to raise its potential, the liquid then discharges its potential to the points in the surface lower than itself, a current flows from the high point to the liquid, from the liquid to the metal at the points lower than itself; the circuit is then complete, and local corrosion, as pitting, is the result.

This discussion on corrosion is made necessary by the subject matter that is to follow. The statements made above will be referred to in many places and would not be understood unless explained beforehand.

Abrasion is due to the wearing away of one substance by rubbing against another. In vessels' hulls it is mostly noticeable on the bows where rubbed and abraded by the anchors and chains. In their engines and machinery it is noticeable in the bearings, guides and similar construction, especially when not properly cared for. Its effect on the hull material is not serious and cannot be prevented in wake of the anchors and chains. There is no danger of damage from that source.

Erosion is due to the wash or scouring action of liquids or gases over metal at high velocities. With the exception of valves, and maybe in a few other places about the machinery, its effect will not cause sufficient loss to be noticeable.

Metals used in the construction of the hulls of vessels are: Steel for plates, angles, beams, rivets, struts and external and internal braces and hull fittings. Composition castings for sea chests and propellers. The compositions generally used are manganese and phosphor bronzes; monel metals (nickel bronzes) and an 88 copper, 10 tin, and 2 zinc bronze.

* A paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1912.

Steels are extremely variable in the way in which they corrode and in their effect upon other steels to which they are connected by metallic contact. These variations are due to the differences in chemical compositions and to the differences in state of stress of the molecules of the metals in their wetted surfaces. These different stresses are in turn due to the different workings the metal has received, the temperatures at which it has been worked, and to the heat treatment finally given the finished product. Two pieces of steel from the same plate may vary perceptibly in the way in which they corrode and in the loss of weight per unit of area in a unit of time due to the above causes; that is, certain constituents may be segregated over the surface of one piece and not over the other, or different stresses may exist in the two surfaces, due to the different ways in which they have been worked or treated. An angle-bar corrodes more quickly than a plate of steel of practically the same constituents; a bent plate or angle-bar corrodes in and near the bend more quickly than the straight part. There is always more corrosion around the entrance, run and bilge of a vessel where all of the hull plates and frames are bent than along the straight body. A rivet that has been hammered and upset corrodes faster than the same rivet before it was hammered. The assumption that any piece of steel is a homogeneous body, either as to chemical contents or as to physical stress, is one that can very easily be disapproved by sufficient chemical analyses and by photomicrographic work. The writer was much surprised to note the differences in chemical composition and photomicrographic results in a boiler tube, samples taken (1) over the expanded surface and (2) over the unexpanded surfaces. He was also surprised to see the different ways in which boiler tubes corroded over the same areas, as shown both by Cushman and Walker's ferroxyl mount and by actual immersion. Steels are of higher potential than water at ordinary atmospheric temperatures.

Copper and copper compositions vary in the way they corrode. These variations are due to chemical compositions, variable temperatures, and to the way in which they have been worked, producing stresses in the surfaces of the finished product. At ordinary atmospheric temperatures copper and its compositions are of lower potential than water, *i. e.*, they are said to be electro-negative to water. As their temperatures are increased or as they are stressed to higher degrees their potentials increase faster than does the water in which they are immersed, and if the temperatures or stresses are raised sufficiently they become of higher potential than water and corrode or dissolve similarly to steel. As a proof of this, from observation on shipboard for thirteen years, copper and composition piping corrode faster at the bends and near flanges than at the straight parts, and pipes in which the temperatures are different in different places, such as feed piping through feed heaters, condenser and circulation piping, and other piping which is at different temperatures over different parts, corrode faster than do the fire mains and other piping which are at the same temperature throughout. Two pieces of copper or composition cut from the same plate, treated in the same way, may show no difference of potential when immersed together in water and connected through a potentiometer. Then if one piece is removed and hammered, worked or heated, and replaced, it will show that it is electro-positive to the unworked piece, and it will corrode if placed in water of a certain temperature in which the other piece may or may not be affected according to the treatment and chemical composition of the original sample. Composition castings are generally of a very uniformly stressed surface, due to the heat treatment naturally given in coaling. Those placed as sea chests in ships require no protective coating, and seldom, if ever, give any trouble, and the highest temperatures to which they are subjected are not sufficient to raise their potentials to equal that of the sea water in which immersed. If the copper compositions are segregated, and these segregated spots are of higher potential than sea water, they dissolve away and pit to the depth to which the segregations extend.

These compositions are negative or lower in electrical potential than ordinary or sea waters, while steels are electro-positive or of higher potential than the same waters at ordinary temperatures. If the bare steel is immersed in the water it will corrode or dissolve at all points in its wetted surface, while the composition casting in the same waters will not corrode at any of its points. If these two metals are connected by a perfect metallic contact and immersed in the same water, the rate of corrosion over the steel will be greatly increased. The rate at which it will be increased all over its surface will depend upon the perfection of the metallic contact; if there is no such contact the presence of the composition will not increase the rate of corrosion on the steel, no matter how close together they may be. If the steel is covered with a moisture-proof paint and the same contact as above made, it will not corrode when connected by a perfect metallic contact with the compositions, but if the film of the moisture-proof paint is broken so that any part of the steel surface is exposed to the water it will corrode rapidly over the exposed part.

Where these composition castings are secured to the steel hull of a vessel it is customary to secure plates or rings of rolled zinc as a protection to the steel, the idea being that the zinc, being of higher potential than the steel, will corrode and preserve the steel. That this assumption is thought to be correct is evidenced by the great use of zincs at a very large cost in these places. Yet the writer has failed to see that the assumption is positively correct for the following reasons: (1) Zinc quickly corrodes and becomes covered with zinc oxide, and zinc oxide from boiler, condenser and hull zincs has been found to be electro-negative to steel in every case tried. (2) In no case has the writer ever had a piece of steel connected to a zinc plate corrode less in the same water in thirty days than a piece of steel from the same plate placed alongside the first plate, but not connected to zinc. (3) The steel around the sea chests of the bottom blow discharges, if properly painted, does not show more corrosion than does that around the other discharges, and the writer has never seen a ship docked that had any zinc in the bottom blow discharges, they evidently having deteriorated and been blown out soon after the previous undocking. (4) It has been noticed on many occasions that the only steel attacked by corrosion in the vicinity of the zinc plates was that of the steel screws holding the zincs in place. Therefore the writer fails to see the necessity of the zinc protectors, especially as he has just seen the bottom of a ship on which, after having been in the water over six months, there were no signs of corrosion at any point when the paint film was unbroken except on the zinc.

The use of zincs and other metals electro-positive to steel in galvanizing, electro-plating, or other similar covering processes, as a preservative for it, when continuously immersed in water, is a dangerous one, and is not to be commended for the following reasons: (1) The metal covering must be electro-positive to the steel or metal to be protected, therefore it is more soluble in water and will dissolve more quickly. (2) When the steel is once exposed to the action of the water it corrodes rapidly over the exposed surface, and if not stopped by some similar covering it will pit through before other surfaces are uncovered. (3) For hull and ship fittings generally a surface once exposed cannot be again covered. (4) The stable oxides of all metals are lower in the potential series than the pure metals, therefore the oxide of the coating may be lower in potential than the metal to be

protected, and actually does harm instead of good where the steel is exposed.

For the protection of the hull construction it therefore remains only (1) to provide the most homogeneous metals possible both in regard to chemical composition and physical structure. (2) Paint the completed structure with a complete film of the best anti-corrosive paint that can be obtained, after having cleaned the surfaces of all foreign matter and rust and dried them thoroughly. After this film of paint is dried give the surfaces a second coat of the same paint; after this coat is dry paint with an anti-fouling paint for all outboard, under-water structures and with the best moisture-excluding paint for all other surfaces. (3) Dock frequently and remove any rust that may be found, and repaint as may be necessary. (4) On inboard structures remove all paint that shows active corrosion under it, and when thoroughly cleaned and dry repaint as before.

The subject of proper painting is a very important one and one that must be thoroughly understood to obtain good results. There are three necessary points that must be observed and understood as follows: How to paint, when to paint, and what kind of paint to use for the different conditions the paint has to stand.

How to paint involves the question of the proper preparation of the surfaces, the proper preparation of the paint, and a proper spreading rate of the kind of paint used.

When to paint involves the question of the dryness of the surfaces and the atmospheric conditions in the vicinity of the surfaces. What kind of paint to use involves the questions of whether the paint is to be used (1) as a protection to the metal (anti-corrosive and waterproof paint), (2) as a cleanser of the paint film of marine growth (anti-fouling or poisoned paints), (3) as a decoration to the structure (covering and coloring paint). In any of the above cases the paint film when dry should have about the same coefficient of expansion as the metal to be covered, or the painting will crack or become loosened from the surfaces, and any good effect, even unto decoration, will be lost. An anti-corrosive paint is one that, when well dried, is impervious to moisture, and keeps the metallic surface dry, so that no active corrosion can take place, and one that, when moisture does percolate through it to the metal, dissolves and raises the potential of the enclosed water to a point as high or higher than that of any metal exposed to it. To perform this last function the pigments of the paint must be higher in the electromotive series than the metal to be covered, and to perform the first the pigments and solvent must form a homogeneous film over the whole of the covered metal. An anti-fouling paint is one that, when any marine growth sticks on its surface, either poisons the growth and allows it to drop off or dissolves under the growth, due to its secretions, and allows it to loosen and float away. Decoration or distinguishing paints are those used to decorate the living quarters or to distinguish different kinds of piping. About the only requirement for them is that they must have a pleasing or distinctive color, and the color must last as long as possible under the conditions of the service to which they are exposed. Many good anti-corrosive paints are not good waterproof ones; therefore, unless the anti-corrosive paint is a good waterproof one, it should be covered with a good waterproof paint, for the protective effect of a non-corrosive paint is obtained at the expense of the paint unless it is also a good waterproof one. As soon as enough of the paint is dissolved off to enable a free circulation of water to the surface of the metal the anti-corrosive effect is lost. Proper painting is a most important aid in the preservation of metals, and no effort should be spared to obtain it. The first cost of painting for the protective effect must be disregarded, and the best paint obtainable for the purpose used and applied with the greatest care. There is a general tendency in some directions to regard painting as only for decorative purposes and to consider that the cheap paints frequently applied are the best. Even for decorative purposes this is not true, because a proper paint properly applied will generally last at least three times as long as an improper one at half the price. Judging from the amount of surface to be covered, the conditions of its service, the number of men to do the work, and the other work they have to do, the best paint, properly applied, is none too good and should be obtained at any cost. The writer once put a coat of white enamel paint on the above-water sides of a gunboat in service on the Yangstze-Kiang River which lasted without retouching for over one year. It looked well all the while although washed daily with muddy river water.

As active corrosion cannot take place on dry metals it may often be better not to remove a good film of paint that has been put on over dry dust, and through which no signs of active corrosion are visible, than to spoil the paint for the purpose of removing dry and therefore harmless rust unless it is perfectly sure that a properly dried paint film can again be obtained over perfectly dry metal. The writer has on several occasions done more harm than good by removing good, dry paint films previously put on over dry rust because he could not get the surfaces dry and a proper film of good paint to stick to them.

The metals used in machinery, boilers and their accessories and piping are many, such as

Cast iron for cylinders and engine housings.

Steel for steam pipes, boilers, shafting, tanks, evaporators, condensers, feed pipes and general piping.

Composition for water boilers, of pumps, water pipes, valve fittings, boiler fittings, condenser tubes and in other places.

Copper for small piping and in other places.

Monel metal for valve fittings, pump liners, pump rods and such other places.

Cast steel for superheated steam valves, slip-joint castings, etc.

Lead as a lining for iron or steel pipes.

Other metals are used but the above are the principal ones. The same observations apply to these metals that can be painted as previously stated for hull materials.

Oil films are moisture-proof when applied to dry metals, therefore there is very little if any corrosion taking place about an engine when it is in use. Paint around the usual main engines and their framing is unnecessary unless the engine is to be laid up for a long period, and, if used, is for the purpose of decoration only. The external sides of pipes, feed heaters, condensers, boilers, evaporators and tanks can be protected by proper paints. The internal or water side of the above cannot be protected by paints, nor is it generally believed by any other means; though lacquers, galvanizing, lead lining and other means have been tried on pipes, they have all proved unsatisfactory, in some cases due to the unequal coefficients of expansion of the coating and metal, in some to the solubility of the lacquer, and in others to the fact that the metallic coating cannot be properly applied to the finished article. As the life of piping, boiler plates and other parts is no greater than the weaker part, the piece fails when improperly protected. Boiler, condenser, feed-water, distiller and evaporator tubes cannot be protected on either side by paints, lacquers and coatings. Therefore all such parts should be made of homogeneous metals properly heat-treated after being finished, and then fitted properly so that the least possible internal strains are brought into it due to the fitting.

It has been definitely proved that any water made alkaline enough to show 3 percent of normal alkalinity with calcined sodium carbonate is non-corrosive to steel at all temperatures up to 422 degrees F. Therefore if the water in the boilers, tanks, evaporators and feed piping is kept at or above that strength with sodium carbonate at all times, no corrosion will take place, while if the strength is allowed to fall to about

1.8 to 2.5 percent, bad pitting will take place. In trying to reproduce the pitting continually taking place in boilers, tanks, piping and on bilge plates with acid solution, or plain sea or distilled water, the writer failed in every instance on three grades of nearly pure irons, three grades of boiler steel, and on four grades of cast iron. It was easy to produce such similar pittings on all of them when immersed in weak alkaline and very weak carbonate solutions. For the above reasons it is believed by the writer that much more harm is done in enclosed metal vessels by water made slightly alkaline, either artificially or naturally, than is ever done by the small percentage of acids that ever enters the average boiler. Boilers and other water-containing metal vessels or conduits containing acid water will go to pieces quickly, practically all over at the same time; those containing sea or distilled water will go to pieces all over at the same time but very slowly; those containing alkaline water of a strength not high enough to stop all corrosion will go to pieces in the weaker places, while other parts or places will remain perfectly good. If the percentage of alkalinity is high enough no corrosion whatever will take place. The reason for this is believed to be as follows:

1. Water has a certain definite potential at any definite temperature.

2. Pure distilled water has a potential lower than that of steels, irons and some alloys.

3. Acids added to pure distilled water at any temperature decrease its potential.

4. Alkaline substance dissolved in pure distilled water increases its potential.

5. The decrease of the potential of water when an acid is dissolved in it is due to the fact that the negative ion of the acid is lower in potential than that of the hydroxyl OH of water, the H ion being common.

The increase in potential of water when an alkaline substance is added to it is due to the fact that the metallic or positive ion of the alkali is higher in the potential series than hydrogen, while the hydroxyl or negative ion is common to both.

6. When any metal is wet by any water solution, if the potential of the solution is (*a*) higher than that of the metal at every point on its surface, the metal will not corrode; (*b*) higher than some points in the metal surface and lower than that in others, the metal will corrode only over the areas where the potential of the solution is the lower; and it will corrode faster over those points than it would if immersed in distilled water alone, due to the fact that though the difference of potential between that of the metal and that of the alkaline solution is less than it would have been in distilled water, yet the conductivity of the water has been greatly increased by the addition of the alkaline substance; (*c*) lower than that of the metal at any point it will corrode all over at the same time, faster over the higher potential points than over the lower ones. The rate of corrosion over all of the points will depend both upon the difference of potential between the metal at the point and the solution, and also upon the conductivity of the solution. As the alkalinity of the solution decreases, the difference of potential between the metal and the water increases and the conductivity of the solution decreases until pure water is reached. Any addition of an acid then increases the difference of potential between the metal and the solution and also increases the conductivity of the solution. When considered with a given metal the potential of some alkaline solutions increase faster with a rise in temperature than does that of the metal, therefore a solution that may not be dangerous at ordinary atmospheric temperature may be strongly active to the same metal at higher temperatures.

Also a solution that may be strongly active to metals at atmospheric temperatures may be non-corrosive entirely at still higher ones.

The converse may be true with some of the alkaline substances; that is, a rise in temperature may not increase the potential of the solution as fast as it does the metal and a safe solution at atmospheric temperatures may be unsafe at higher ones. In the writer's experiments with alkaline solutions the general rule was that a one one-hundred-thousandth and a one ten-thousandth normal concentration of alkaline solutions decreased the rate of corrosion of irons and steels slightly below that in distilled water and caused no pitting, while the one one-thousandth and one-hundredth concentrations increased the rate above that, and caused very active local corrosion or pitting until the 2.6 percent normal concentration was reached, when all corrosion stopped.

Cement washing the plates of drinking water tanks has its advantages, but the washing must be done with great care, will not stick to paint and is not durable. It must be watched centration was reached, when all corrosion stopped.

The Cumberland Electrical Process appears to be the only way of preserving the interior surfaces of water-carrying pipes and circulating systems. It is on the same principle as the alkaline theory. The potential of the water is raised to a point higher than any point of the system by sending a current from an outside source to it from an easily replaced anode. The current must be at a potential high enough to raise that of the water to the proper point and must be kept on continuously. If the potential of the water drops below that of the metal at any point it will pit or corrode at that point similar to the alkaline solutions. This system will give excellent results when properly installed and properly attended.

The preservation of copper, composition or iron piping on board ships in the flushing, condenser and refrigerator circulating systems can be maintained by the Cumberland process if run by some electrical source other than the main power system of the vessel. This process has many drawbacks and requires constant attention. Except by making the piping and tubing of the best and most homogeneous metal obtainable, having it properly made and the finished article properly heat-treated and fitted, it seems to be the only practicable plan available. It is sure if properly controlled.

The wrought iron, steel and other iron manufacturers make many claims for their various materials, claiming maximum durability and resistance to rust. In thirty months of continuous testing of these various products it was interesting to note that in many cases one would show much better than another, but by varying solution, temperature and treatment they could all be made to give practically similar results.

In waters that are made non-corrosive to iron or steel by alkaline solutions, their metallic contact with copper and other metals lower than iron in the potential series does not start corrosion.

These notes and observations are made after thirteen years of active sea service as both an engineer and line officer in the United States navy, and after nearly three years' work on corrosion problems at the United States Naval Academy. The writer offers them for whatever of interest they may be to anyone.

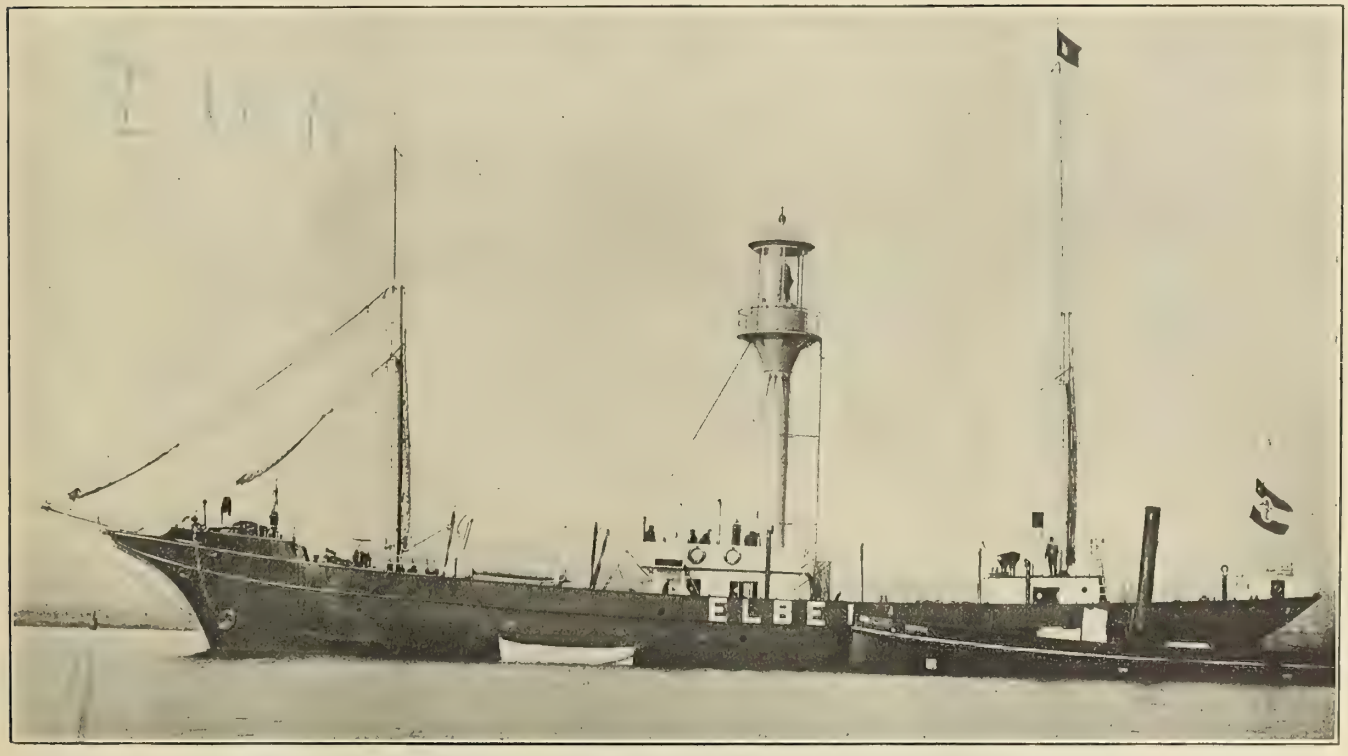
Monthly Shipbuilding Returns.—The Bureau of Navigation reports 109 sailing, steam and unrigged vessels of 38,201 gross tons built in the United States and officially numbered during the month of February. Of the total number of vessels built 8 were steel steamships aggregating 29,294 gross tons. Five of these, aggregating 17,879 gross tons, were built on the Atlantic and the Gulf coasts, while two, aggregating 10,088 gross tons, were built on the Great Lakes. The largest of the vessels completed was the naval collier *Jason* of 10,650 gross tons, built by the Maryland Steel Company, Sparrows Point, Md.

Motor Lightship Bürgermeister O'Swald

BY J. RENDELL WILSON

Shortly after the *Titanic* disaster it was suggested that a number of Diesel-engined lightships should be built by the Great Powers and stationed in those parts of the Atlantic most subject to icebergs. Such craft would be equipped with wireless telegraph installations, and would be able to warn the great liners and other ships. The advantage of motor power for such ships would be that they would have four times the cruising range of steamboats of similar displacement —in fact, one "oiling" would probably be sufficient to last the whole of the period in which icebergs are generally to be found in the steamship track, especially as unusually large fuel tanks can be installed where an ordinary craft would carry cargo or passengers.

An interesting vessel of this class has just been built and stationed in the North Sea at the mouth of the river Elbe



ELBE LIGHTSHIP FITTED WITH A 220-B.H.P. REVERSIBLE SULZER-DIESEL ENGINE

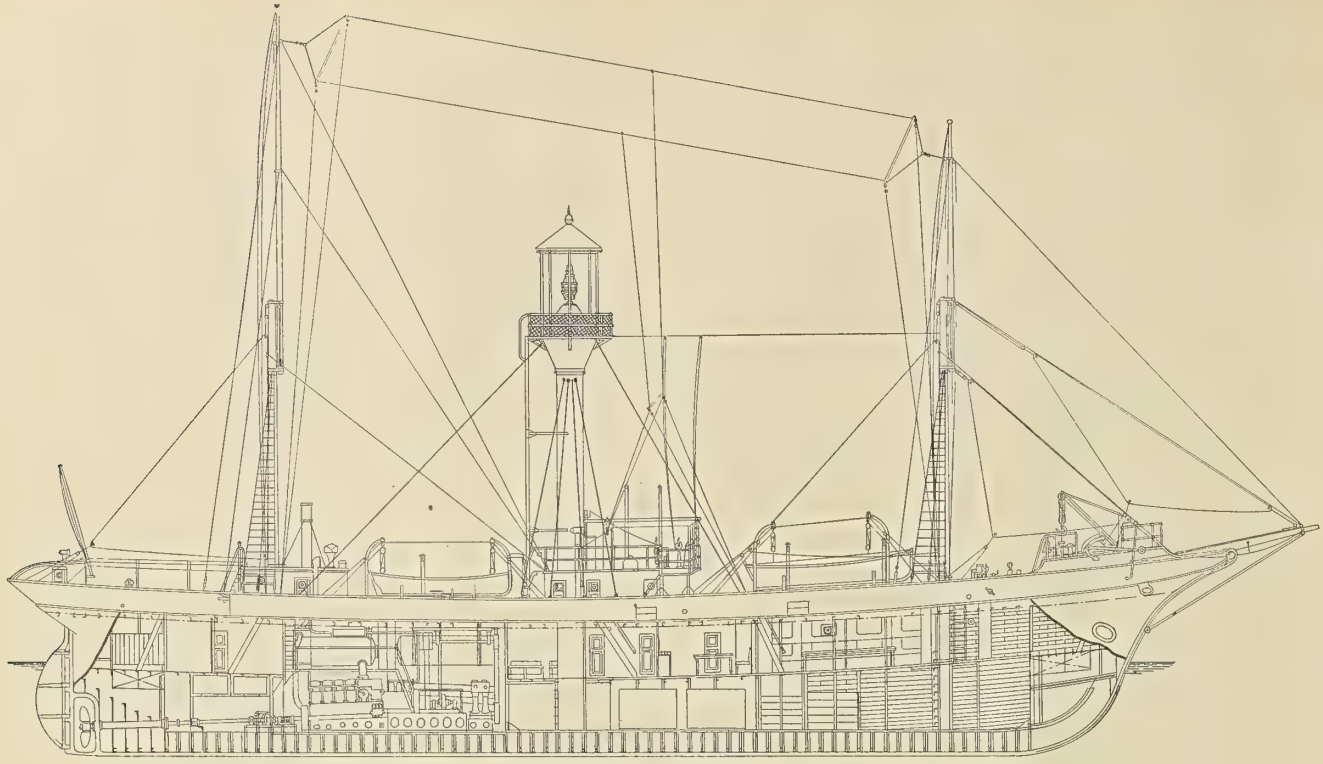
by the Handel, Schiffahrt, and Gewerbe des Hamburger Staates. She is just under 173 feet in length overall, 137½ feet on waterline, by 25 feet 3 inches beam, with 17 feet 4 inches molded depth, and has a draft of 13 feet 1 inch on a displacement of 720 tons. She was built from designs by M. H. E. Johns, of Hamburg, at the Stettin yard of Messrs. Nüscke & Co., to the German-Lloyd Class 100 A-4, and is rather a smart-looking craft with clipper stem and a good sheer line. A complete wireless installation has been fitted. She has been named *Bürgermeister O'Swald.*

The special interest in this vessel lies, of course, in the machinery, both the propelling and auxiliary engines being of the Diesel type, consuming heavy residual oil as fuel, so it will be seen that ordinary running costs will be low, also the machinery—lighting or propulsive—can be stopped or started at a few minutes' notice; whereas the expenses of a steam lightship would be very high, as it would always be necessary to maintain a good head of steam.

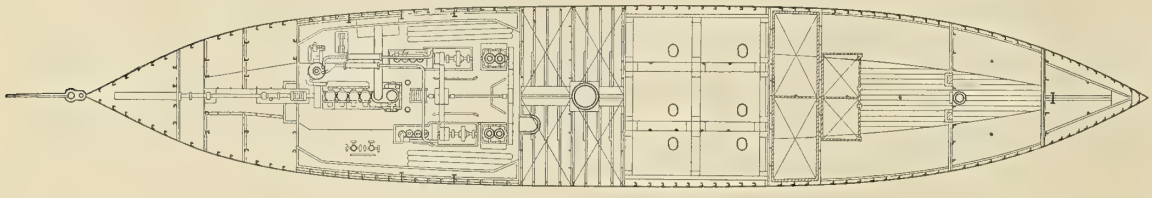
The propelling engine is a direct reversible four-cylinder Sulzer-Diesel of the single-acting, two-stroke type, and develops 220 brake horsepower at 280 revolutions per minute. It was constructed by Messrs. Sulzer Bros. of Winterthur, Switzerland, who, it may be remembered, built the 1,600 horsepower machinery of the Hamburg-South America Company's motor ship *Monte Penedo.* It will be seen from the illustration that the engine is quite self-contained. Its designers have arranged for the driving of the scavenging pump, three-stage air compressor, cooling water pumps, fuel pumps and lubricating oil pumps directly off the main engine crank shaft, or cam shaft, as the case may be.

Starting is by compressed air, which is maintained in cylindrical reservoirs by the second stage compressor. On the upstroke of each piston atmospheric air is compressed in the cylinder to about 450 pounds per square inch pressure; just as the piston reaches the top of the stroke fuel is injected by more highly compressed air through a valve in each cylinder head. The starting and injection valves are operated by a series of rockers and push rods off a cam shaft on the side of the engine. It will be seen that the lower end of each push rod is connected to a small "heel" fitted with a roller running on the cam, the "heel" itself being mounted on a lay shaft carried in bearings just above the cam shaft. By having the lay shaft connected to the control lever it can be given a partial turn, thus varying the timing of the opening of the valves when the engine is reversed. The fuel pumps, four in number, can be seen to the right of the control lever. They are of the plunger type and are operated by eccentrics.

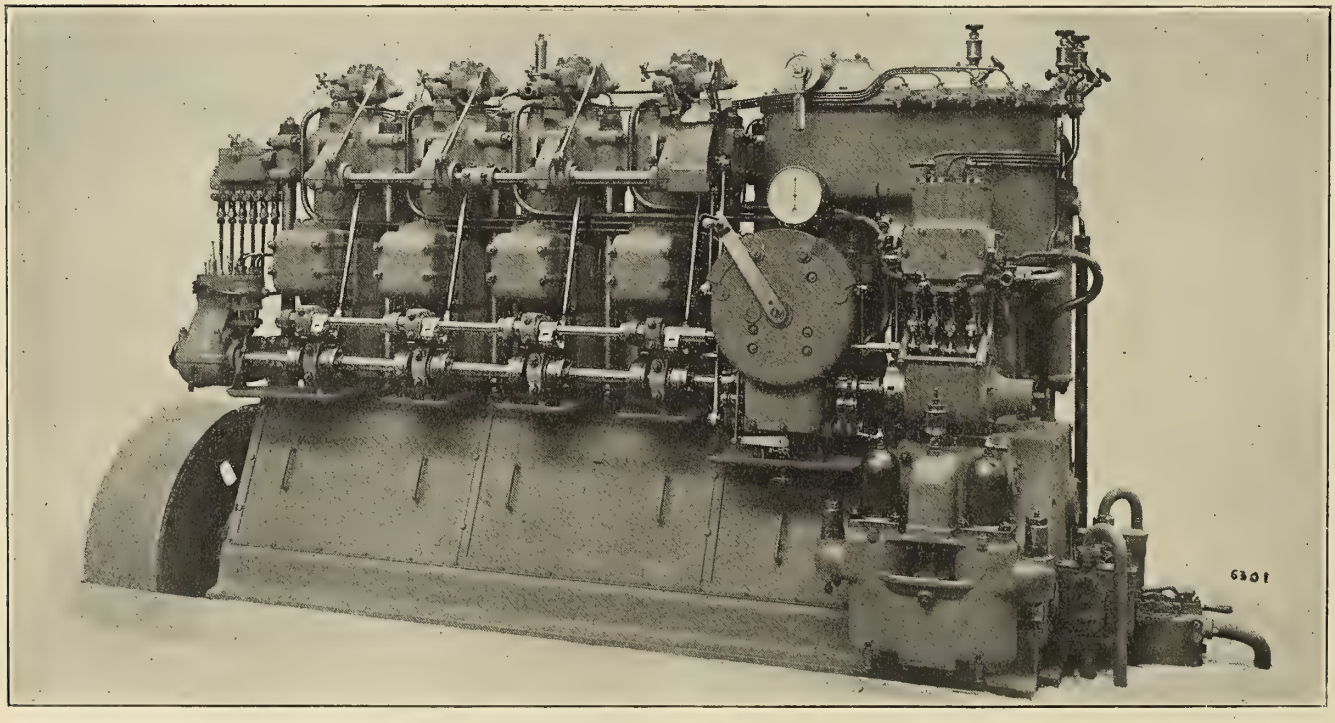
Immediately fuel is injected combustion takes place, and on the down stroke the exhaust port opens, and almost immediately after scavenging air is admitted through another port at the bottom of the cylinder, via the rotary valves from the



PROFILE



HOLD PLAN



220-B.H P. SULZER-DIESEL ENGINE FOR THE ELBE LIGHTSHIP

pumps, and the cylinder is filled with pure atmospheric air. The cycle of operations is then repeated. Each fuel injection valve is fitted with a hand control for regulating the supply of fuel. At the after end of the cam shaft are driven a number of lubricating oil pumps, from which are led pipes to the principal working parts. An interesting feature of the construction is the carrying of the four cylinders on ten massive steel columns bolted to the bedplate and cylinder heads, thus taking away all axial strains and stresses from the body of the cylinders and the crankcase. The latter is of the enclosed type, fitted with three very large steel plate doors on either side. The pistons, by the way, are water cooled, and the water is led through telescopic pipes without stuffing boxes, entering the piston head in the form of a free jet. The power developed by this engine was found on trials sufficient to give the lightship a speed of 9 knots, and no doubt this could be exceeded in the event of an emergency such as a severe gale.

Turning to the auxiliary machinery there are two three-cylinder Diesel motors of the four-stroke type, each developing 35 brake horsepower at 450 revolutions per minute. The after end of each is coupled to a continuous current dynamo for the lighting of the ship and the main lantern, while at the forward end of each is driven a two-stage air compressor for compressing and maintaining air to 220 pounds per square inch for the deck windlass, while by belt off the flywheel is operated another air compressor for supplying air to the fog horn. There is also a single cylinder motor of 6 horsepower turning a two-stage air compressor for charging the main starting reservoirs should the supply run down before the main engine can be got going. There are, of course, accumulators of large capacity as a standby.

Marine Uses of Electric Storage Batteries

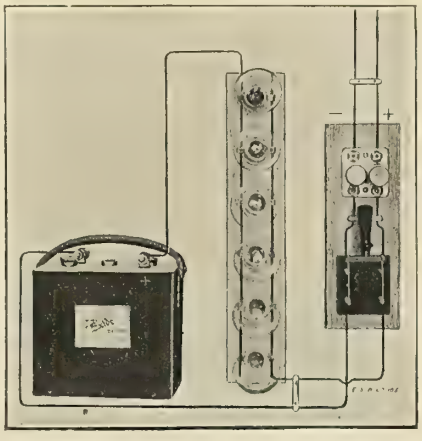
Among the many uses for which electric storage batteries are suitable on board ship the following are perhaps the most extensive and important: For lighting and operating small motors on private yachts, for lighting and engine ignition on motor boats, for propulsion of launches, for gun firing on warships, for stand-by purposes on lightships, for insuring continuity of service in wireless telegraph plants, and, finally, for the propulsion of submarines under water.

Perhaps the most extensive use of storage batteries in marine work is on board private yachts for illumination and operating small motors. Here the battery can be charged during the day from the dynamo while the engine is running, or, if the boat is lying at anchor, charging can be done at any time that is most suitable, and the battery is available for its varied uses when the dynamo and engine are shut down. The battery requires little space and may be placed under the floor or between decks, wherever there is a small amount of available space. The plates of the cells are contained in a specially deep type of rubber jar covered over with a tight-fitting rubber cover. The cells are assembled generally in lead-lined wooden trays. It is evident that small portable batteries of this type would be of particular advantage for lighting on small motor boats. The requirements for a battery for propulsive purposes, however, necessitates a special design which is quite extensively used in boats varying from 18 to 55 feet in length which have a speed of about 5 miles an hour and a considerable radius of action.

A very interesting and important development of storage batteries is furnished in the special application of a three-cell Exide battery, manufactured by the Electric Storage Battery Company, Philadelphia, Pa., for the use of gun firing in the United States navy. Each gun in the vessels thus equipped is supplied with its own battery. The rated capacity is 20 ampere hours when discharging at the 1 ampere rate. In addition to one battery for each gun, each vessel also carries a number of spares, so that the batteries can be released for recharging and yet all guns kept ready for immediate action. The battleships and armored cruisers thus equipped are supplied with a standard charging panel which has been developed by the Bureau of Ordnance. This panel is installed in the electrician's room, and the batteries are taken to that point when they are to be recharged.

Another battery manufactured by the above company, called the iron-clad Exide battery, which is a development of the pasted or Faure type of plate designed for reliability and rugged service, has been selected in recent installations for the United States Lighthouse Department. There has been developed a very high-powered lamp for use on lighthouses and lightships. This light consists of a small 6-volt Tungsten lamp contained in a parabolic reflector usually of from 18 to 20 inches in diameter. The result is that a very powerful beam of light is obtained at an exceedingly low expenditure of energy.

One of the largest and, in many ways, the most interesting application of the storage battery is in the submarine. The first submarine torpedo boat in the United States navy was



EXIDE BATTERY INSTALLATION FOR GUN FIRING

put in commission in 1897. Important advances have been made since then, not only in size and equipment of the boats, but in the special storage battery, which has made the submarine possible. The first boat built, the *Holland,* had in it a battery of 60 cells of the Plante type. Each cell contained 17 plates measuring 23 inches by 15½ inches. The tanks containing these plates were made of steel, and completely covered inside and out by lead sheets. As succeeding boats were built, the type of plate was changed, first to "Manchester Chloride," then to "Manchester Box," and finally to "Exide," which is the type of plate in most general use at the present time. The size of plate has increased to 30 inches by 15 5/16 inches, the number of plates per cell to 27, and the number of cells to 120. The rating of this battery is 2,400 amperes for 1 hour.

The lead-lined tanks were some time ago discarded and a very heavy rubber jar developed. This apparently is the largest size jar ever used in storage battery practice, and has been very satisfactory. The usual method of connecting the plates from jar to jar is that known as the tandem method. With this scheme, each corresponding positive and negative plate in joining jars is burned to a lead-plated copper conductor bar. This makes it possible to easily remove the plates from the jars, and facilitate cleaning. The cells are placed in the lower part of the boat, removable hatches being placed over the battery.

There are at the present time about twenty-five of these submarines in commission, and in all probability within a comparatively short time this number will be doubled.

E. L. REYNOLDS.

New Steamers for Chesapeake Bay Service

The Maryland Steel Company, of Sparrow's Point, Md., recently completed and delivered to the Baltimore, Chesapeake & Atlantic Railway Company two modern side-wheel steamboats, the *Dorchester* and *Talbot,* for night service on Chesapeake Bay and tributaries, equipped to accommodate 400 passengers.

These vessels are the latest development of this type of boat as far as increased accommodations are concerned. The patented Isherwood system of longitudinal framing was decided on for a reduction in weight and the necessary rigidity. Over the one-knot Kent Island course, maintained by the builders, the *Talbot* made an average of 14½ miles per hour in three runs.

The length of the boats over all is 200 feet, the length between perpendiculars 192 feet, the molded beam 36 feet, the beam over guards 59 feet 6 inches, and the molded depth 11 feet. The specified draft of the boat ready for service was 6 feet 6 inches, mean.

FIG. 1.—ISHERWOOD FRAMED, SIDE-WHEEL STEAMER DORCHESTER

General Arrangement

The crew, waiters, cooks, firemen and chambermaids are located on the lower deck. Accommodations are also provided for first and second class, white and colored passengers on this deck, with a second class smoking room just forward of boiler room. At the forward end of main deck are located the toilets for crew and second class passengers. Abreast the casings at the sides of the boat are located the office, mail room, package rooms, ice house and storerooms. The galley is located at the after end of the engine casing. At the after end of the main deck there are eight staterooms, a wash room, barber shop and smoking room. On the saloon deck are two bedrooms with private baths, forty-five staterooms, the purser's stateroom, the dining saloon, pantry and lounging room. Separate toilets are provided for white and colored passengers. On the gallery deck are thirty staterooms, the pilot house and officers' quarters.

All joiner work is of white pine. The finish of the smoking room is in hardwood, and all finish of berths, etc., is also of hardwood. The floors of the dining room, pantry, toilets, lounging and wash rooms on the saloon deck and the floor of the forward part of the saloon deck in the cabin in line with the forward staterooms, are covered with interlocking rubber tiling, while the floors in the barroom, washrooms and toilets on the main deck and in the galley and cooling room are covered with asbestolith. The treads of the main stairs are covered with rubber.

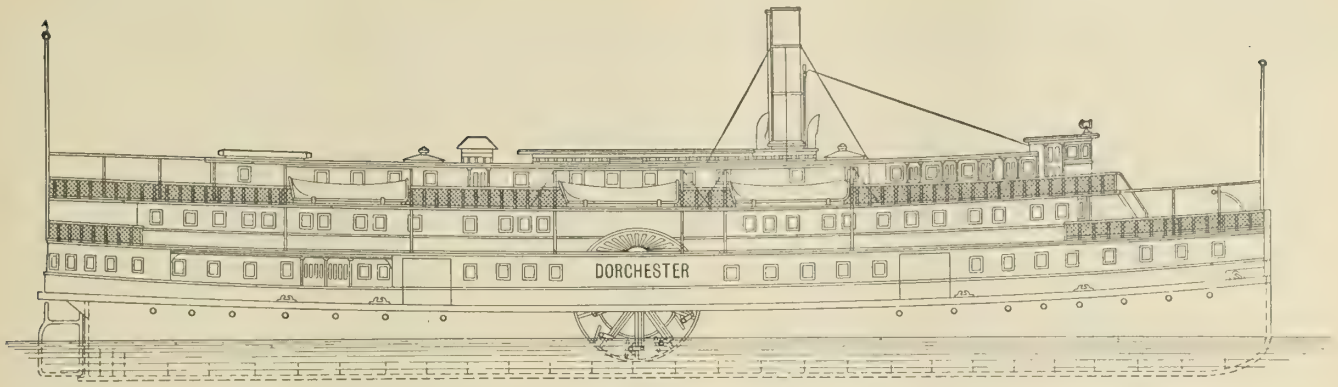
A McCune Howell vacuum cleaning apparatus, large enough to operate two sweepers simultaneously, is provided, capable of supplying 70 cubic feet of fresh air displacement at the vacuum producer per minute. The vacuum producer is controlled by an automatic regulator which can be adjusted to suit requirements.

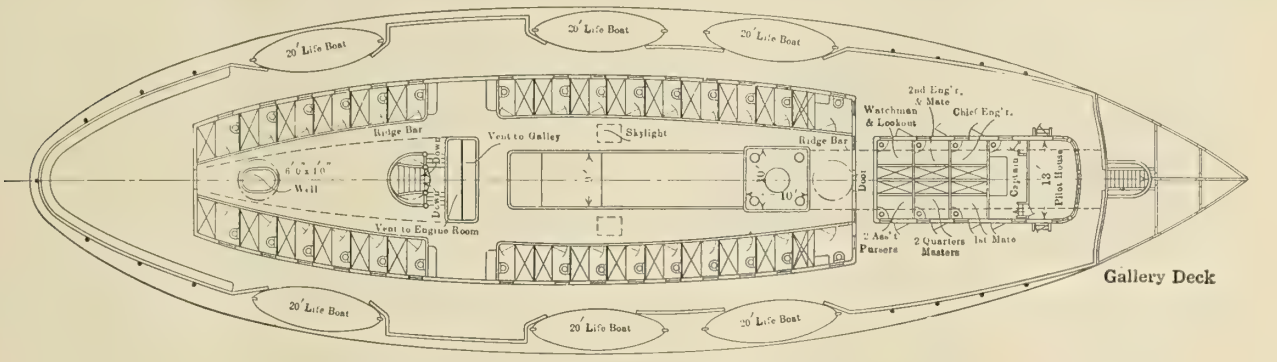
The vessel is heated throughout with steam and lighted with electricity. Running water is fitted to all rooms. Adequate fire mains and hose are installed, and sufficient lifeboats and rafts to carry all of the passengers and crew are provided.

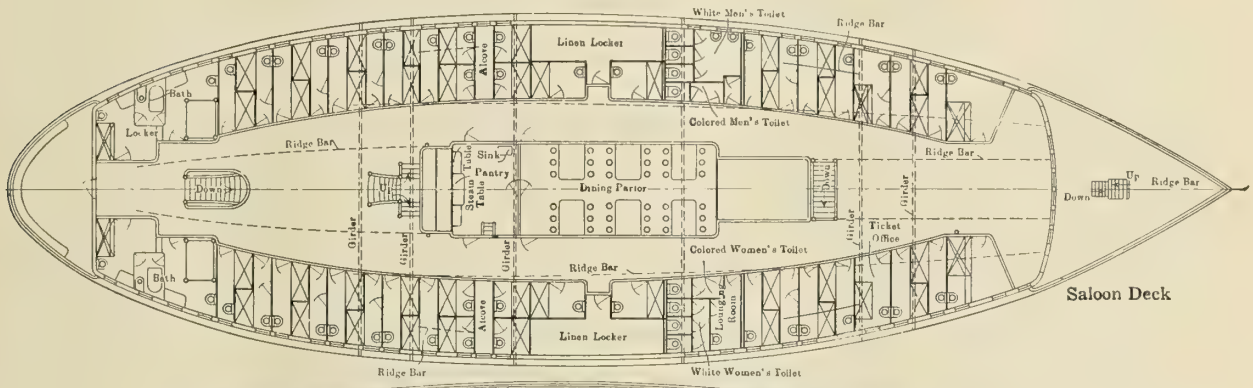
Main Engines

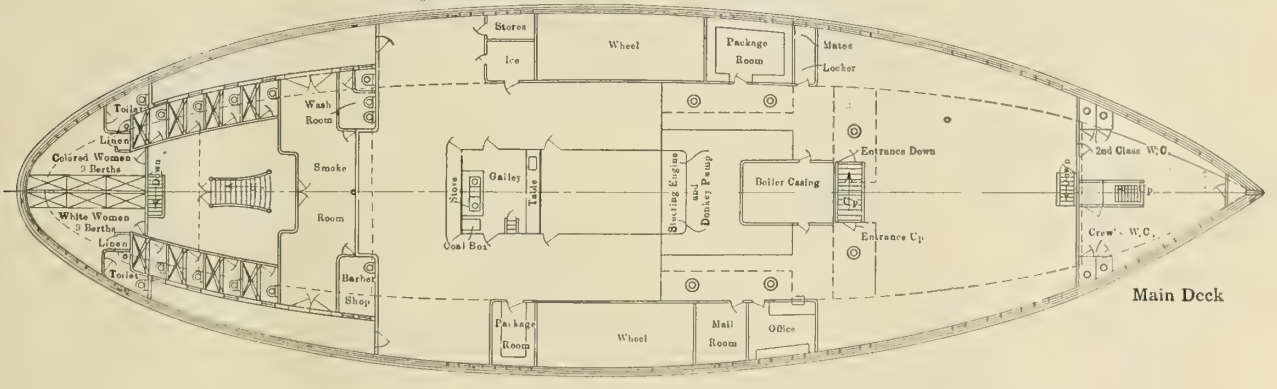
The machinery for these ships is of novel design. The main engine is of the two-cylinder, inclined, surface-condensing type, with Corliss valves, having cylinders 30 inches diameter by 8 feet stroke. This type was adopted because of the economy and ease of operation, and also by the saving of the valuable space usually occupied by the gallows frame, walking beam, etc., of the old beam engine. The main bearings rest directly upon the cast iron condenser shell, and are connected to the cylinders by wrought steel thrust rods or braces. These rods are of rectangular section near the cylinder end and form the crosshead guides. They are supported at about mid-length by forged steel stanchions; these stanchions rest upon a cast iron bedplate.

The cylinders are lagged separately, bolted together, and rest on an inclined plate and angle foundation. The valves are of the Corliss type and work in separate hard cast iron working liners. The valve gear is of the Corliss type, similar to regular stationary plants, with wrist plates, dash pots, releasing gear, etc. The reversing is effected by means of a set of Stephenson links, which are controlled by a steam ram located on the bedplate. The connecting rods are 17 feet 6 inches between centers, of the forked type, with brass boxes having bolted connections at both ends. The piston rods are 8 inches diameter and hollow. They pass through the back heads and form tail rods, which are supported by cast iron slippers with adjustable brass shoes. The crankshaft is 11½ inches diameter in the bearings, the inboard webs for each cylinder having loose pins and brass gibs similar to the arrangement employed on beam engines. The cranks are set at 90 degrees to each other.









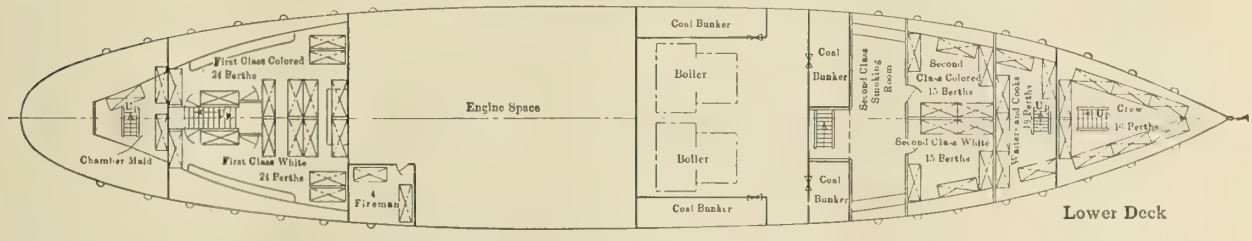


FIG. 2.—PROFILE AND DECK PLANS OF DORCHESTER

The main air pump is of the bucket type, and is driven from the starboard crosshead by steel plate arms and steel rods, the rock shaft being carried by the bedplate. A copper bilge pump is also driven by the air pump crosshead.

The main throttle valve is common to both cylinders, and is operated by levers and rods from the working platform, which is in the lower engine room just outboard of the starboard cylinder. The handling gear stand also supports the reverse

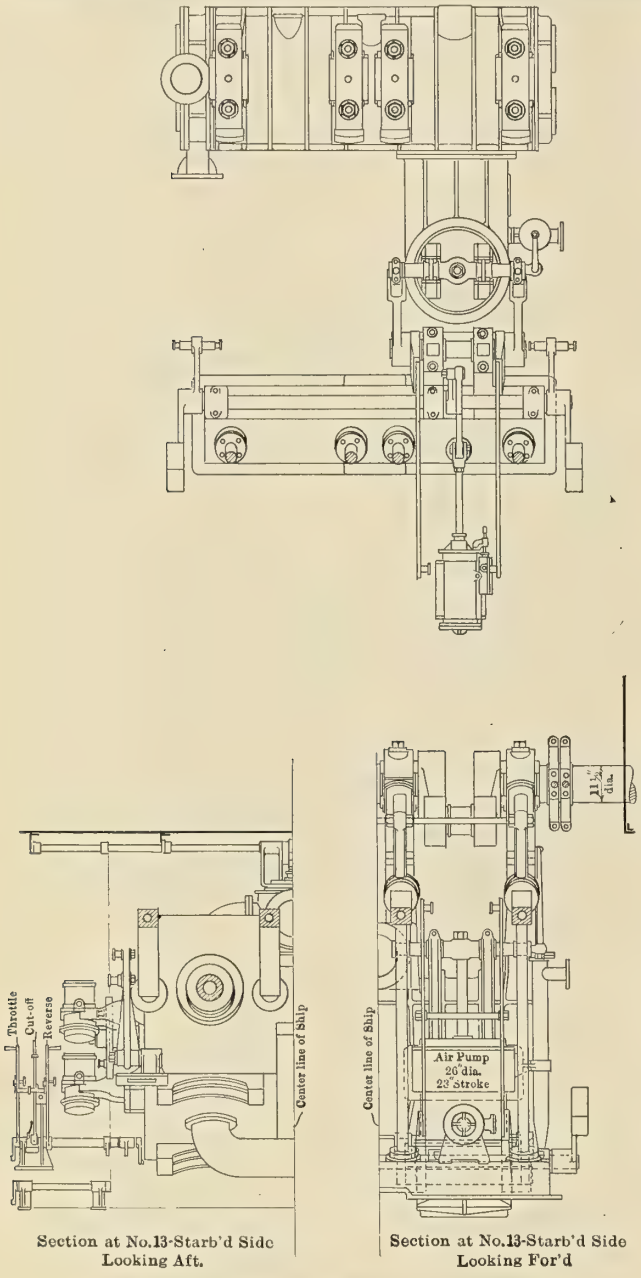


FIG. 3.—SECTIONAL VIEWS OF DORCHESTER'S ENGINE

lever and a lever which regulates the cut-off trip gear, thus abolishing the old beam-engine style of operating the main valves by hand when the engine is running in the astern direction.

The wheels are of the feathering type, 19 feet 4½ inches diameter, each having 10 oak buckets, 8 feet 6 inches long, 3 feet wide and 3¾ inches thick. The arms and rims are of double, refined iron with cast steel fittings.

Boilers

There are two boilers of the water-leg type, 10 feet 1 inch diameter by 13 feet 9 inches long, built for 90 pounds per square inch working pressure. The tubes are 3½ inches diameter, and are 10 feet 7½ inches long. The total heating surface is 3,220 square feet, and the total grate surface 114 square feet. The steam chimney is 8 feet diameter by 12 feet long, with a 57-inch diameter corrugated flue. The boilers are fitted with feed circulators and flue blowers.

Auxiliary Machinery

All the auxiliary machines are located in the lower engine room, and consist of the following: One 10-inch centrifugal circulator, driven by a vertical single-cylinder steam engine, one 10-inch, 7-inch by 12 inch simplex feed pump, one 12-inch, 7-inch by 12-inch simplex donkey pump, one horizontal simplex sanitary pump, one horizontal simplex fresh water pump, two double tube injectors, a steel plate filter box and a 25-kilowatt, 110-volt electric generator, driven by a vertical single-cylinder steam engine. The vacuum cleaning plant is also located in the lower engine room.

The arrangement and material of the piping throughout are of the highest class, all the main steam and exhaust, circulating, feed and escape piping being of copper.

These boats have been in service about six months and the machinery has proved entirely satisfactory in every respect.

An Oil Driven River Vessel

It is appropriate that the British Petroleum Company should decide upon adopting the use of oil for propelling the vessels used in its service so far as practicable, and some particulars of a new 150-ton oil-carrying barge which was recently placed in service on the River Thames for that company will therefore be of interest.

The vessel, which was named *White May*, was built at the Hubertina Works, Veerpolden, Haarlem, and was towed over to England during very rough weather. She is 105 feet in length by 17 feet 9 inches beam, with 6 feet molded depth and 4 feet 9 inches draft on a displacement of 150 tons. Her normal carrying capacity is 100 tons, but if necessary she can take 130 tons aboard with safety. She is steel built of 5/16-inch plating throughout, and the hull is divided into three compartments by bulkheads. Forward is the forecastle fitted with folding bunks, table, stove, etc., for the crew, while aft of this space is the hold having two splash bulkheads. On deck there is a 4-inch iron pipe running the length of the hold, which is used as a suction and delivery system for emptying or loading the cargo. There are two connections to the pumps ashore and three to the hold, the latter being fitted with large screw-down valves. This piping is of sufficient capacity to allow the boat to be emptied in an hour.

Aft of the hold is the engine room, which contains a two-cylinder Kromhout motor installed by Messrs. Perman & Co., Ltd., of London, consuming kerosene (paraffin) as fuel and driving a solid propeller through an epicyclic reverse gear. The cylinders are 11 13/16-inch bore by 14 15/16-inch stroke and 76 brake-horsepower is developed at 265 revolutions per minute on a fuel consumption of 57 pints per hour , or .75 pint per horsepower hour. Under a full load of 100 tons the barge has attained a speed of 7.35 knots, her designed speed being 7.25 knots. Regarding the engine, the following points of interest may be noted: Starting up is effected by petrol, and on each cylinder there is a small brass container which contains just sufficient spirit for the engine to run until the vaporizing plate over the exhaust valve is heated, when the change over automatically takes place. The petrol is fed to the containers from a small tank on deck, and is cut off immediately the required quantity has entered the afore-mentioned containers, so that there can be no danger of fire or explosion from using the lighter fuel. Lubrication is by sight drip-feed, the lubricators being fed from a brass reservoir over the engine. Governing is on the hit-and-miss principle,

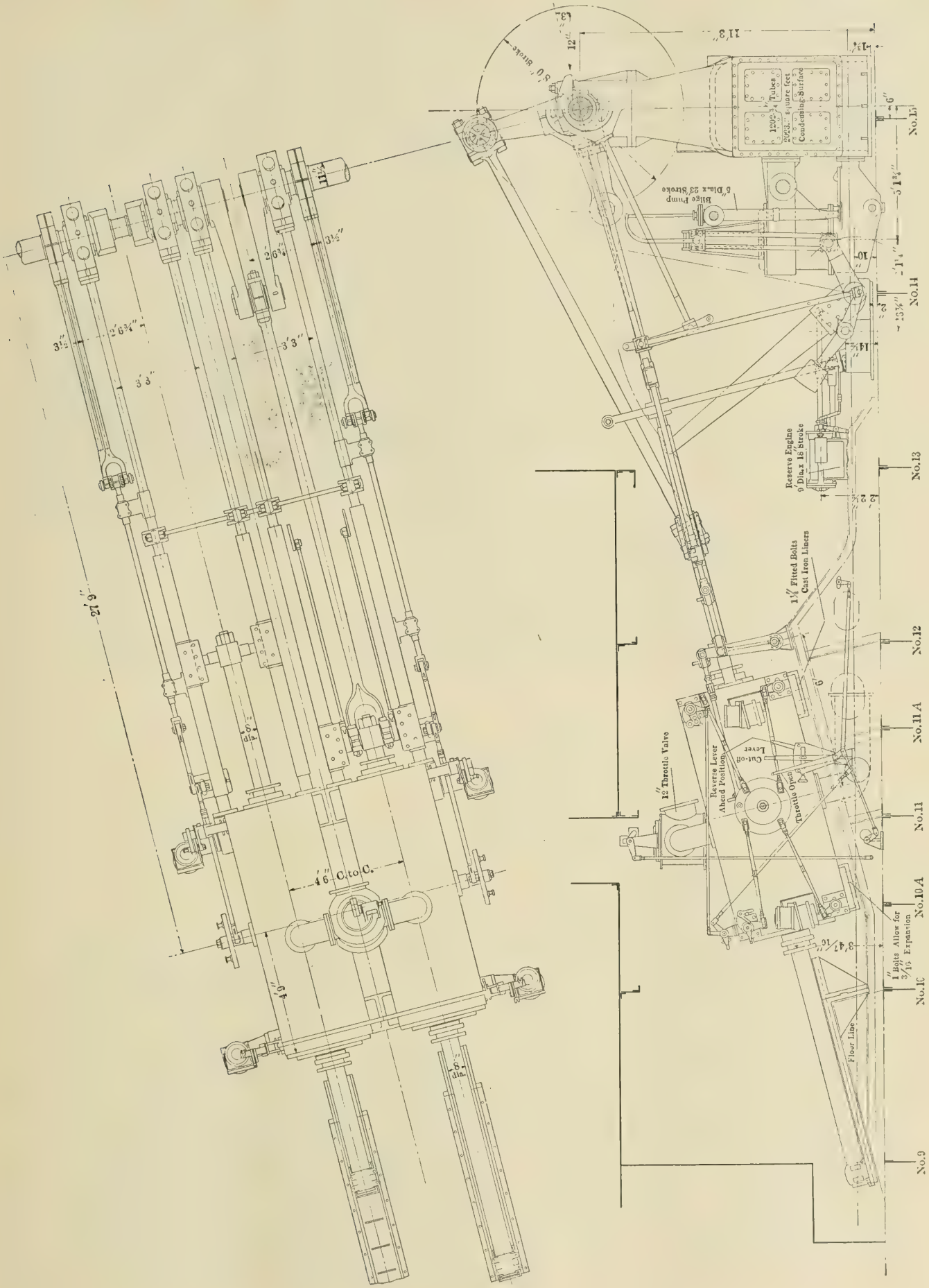


FIG. 4.—TWO-CYLINDER, INCLINED ENGINE FITTED WITH CORLISS TYPE VALVE GEAR FOR SIDE-WHEEL STEAMER DORCHESTER

the inlet valve being automatic, so that the action of the governor is to keep the exhaust valve closed when the engine exceeds normal speed. The cooling water is carried direct into the exhaust pipe, the water being automatically cut off under the action of the governor. Circulation is maintained by a centrifugal pump driven by friction off the inside rim of the flywheel. To prevent back suction when the engine is stopped, the water is first cut off and the exhaust pipe emptied. Ignition is by Bosch plugs, the current being derived from two "flicking" or trip-drive low tension magnetos. On the top of each cylinder there is a connection to a small tank, which stores compressed air, etc., for the siren. The reverse lever is carried through the deck to the steering wheel over the engine room. By the wheel, which is situated aft, there is a small lever which controls the speed of the engine, so that under ordinary running conditions a man is not required below. There are two drum fuel tanks in the engine room, each with a capacity of 250 gallons.

Steel Harbor Lighter Willard U. Taylor

The new steel harbor lighter *Willard U. Taylor,* shown in Figs. 1 and 2, has just been placed in service by the Undercliff Terminal & Warehouse Company in New York harbor. The lighter was designed by Messrs. Cox & Stevens, of New York, and built under the supervision of this firm at the works of J. H. Dialogue & Son, Camden, N. J. The principal dimensions of the lighter are: Length over all, 110 feet; beam, 30 feet; molded depth, 12 feet.

This lighter possesses a number of points that are unusual in vessels of her type and seems a decided improvement upon existing vessels. The hull is constructed of steel throughout of exceptionally heavy scantling, with a view to securing the strongest and most lasting structure that can be produced. The machinery is placed as far aft as possible in order to secure a large forward hold, and also to leave the forward deck unencumbered. As will be seen from the photograph and drawings, the upper deck is carried out to the sides of the vessel for the full length, thus providing permanent protection for cargo. The quarters for the crew are situated on the upper deck, and as the hoisting engine is located in the forward hold, the result is that the entire deck space from stem to stern, with the exception of the engine and boiler inclosures, is free for the stowage of freight, thus giving unusual cargo capacity for the dimensions of the lighter.

FIG. 2.—HARBOR LIGHTER WILLARD U. TAYLOR

Steam is supplied by a leg-type boiler at a working pressure of 150 pounds per square inch to the main engine, which is of the inverted single-cylinder, direct-acting type, with a cylinder 20 inches diameter and 26 inches stroke. The lighter is heated by steam, and is equipped with a heavy wood spar and derrick boom for handling cargo. A powerful hoisting engine is located in the hold.

Without overloading the lighter can carry 300 tons, and her arrangements for carrying cargo are so well worked out that her load can be taken on or discharged by her own power in a minimum amount of time.

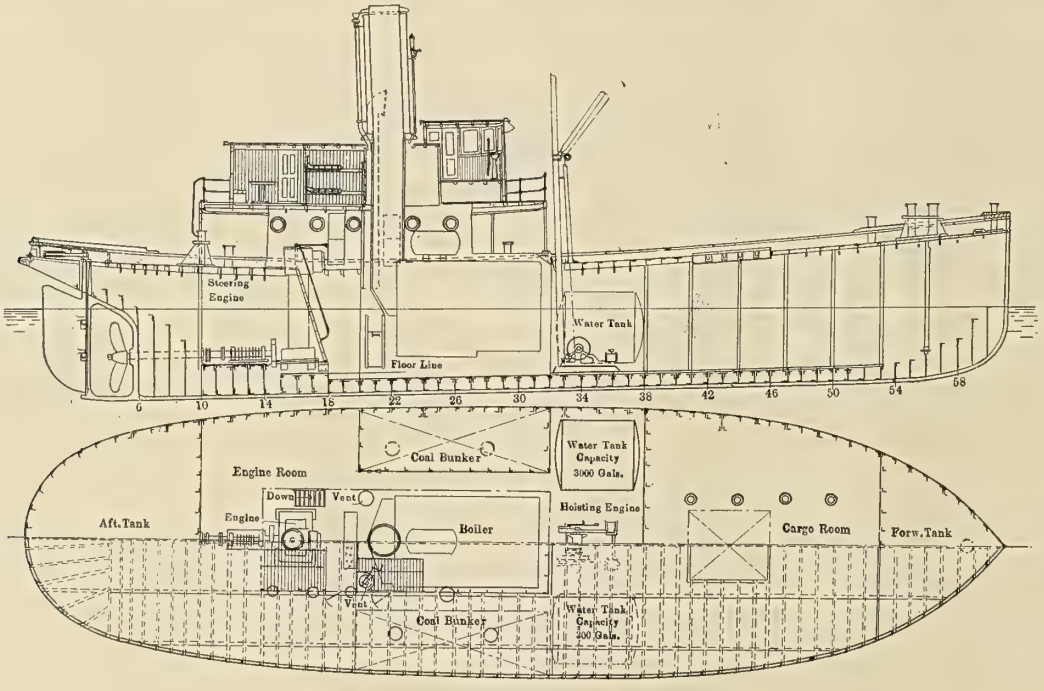


FIG. 1.—GENERAL ARRANGEMENT OF LIGHTER

Motor Yacht Equipped with Diesel Engines

A vessel which should be of special interest to the yachting world is the *Idealia*, recently designed and constructed by the Electric Launch Company, in Bayonne, N. J. The *Idealia* enjoys the distinction of being the first yacht built in America to be equipped with engines working on the Diesel principle.

The *Idealia's* principal dimensions are: Length, 84 feet; beam, 14 feet; mean draft, 4 feet. A recent test showed her metacentric height to be 2 feet, which is considered very satisfactory, as it combines ample stability with seagoing qualities. The model is the same as that recently brought forth by the Electric Launch Company in its designs of 84-foot cruisers, and combines lines which make her easy to drive and at the same time with a comparatively broad beam, to give ample room for comfortable quarters for the crew, owner and guests.

FIG. 1.—MOTOR YACHT IDEALIA, THE FIRST AMERICAN YACHT TO BE EQUIPPED WITH DIESEL ENGINES

A comfortable crew space is located in the forecastle. Abaft of this is the dining saloon with ample seating quarters for a party of eight. The galley is located abaft the dining saloon and extends the full beam of the ship. The engine room occupies a comparatively small portion of the length of the vessel, and is located immediately abaft the galley, being entirely separated therefrom by a watertight bulkhead. In addition to the main engine, which is a 150-horsepower reversible American-Nuremberg heavy oil Diesel motor, the engine room contains a 10-horsepower auxiliary engine, direct connected to a 5-kilowatt generator and an auxiliary air compressor. Tanks for the storage of fuel oil and lubricating oil are built in the sides of the engine room. Thus the entire motive power is contained in a comparatively small space, and yet leaves ample room for the crew and operation of the machinery. The owner's stateroom is located abaft the engine room, and extends the full width of the vessel. Access to the living quarters is obtained by means of the hatchway on the starboard side leading from the spacious lobby on the same side of the vessel. This lobby is immediately abaft the owner's stateroom, and doors open from it into that room as well as into the bathroom and the guests' stateroom, which extends across the ship abaft the lobby. In the after compartment

FIG. 2.—DECK VIEW

FIG. 3.—MAIN SALOON

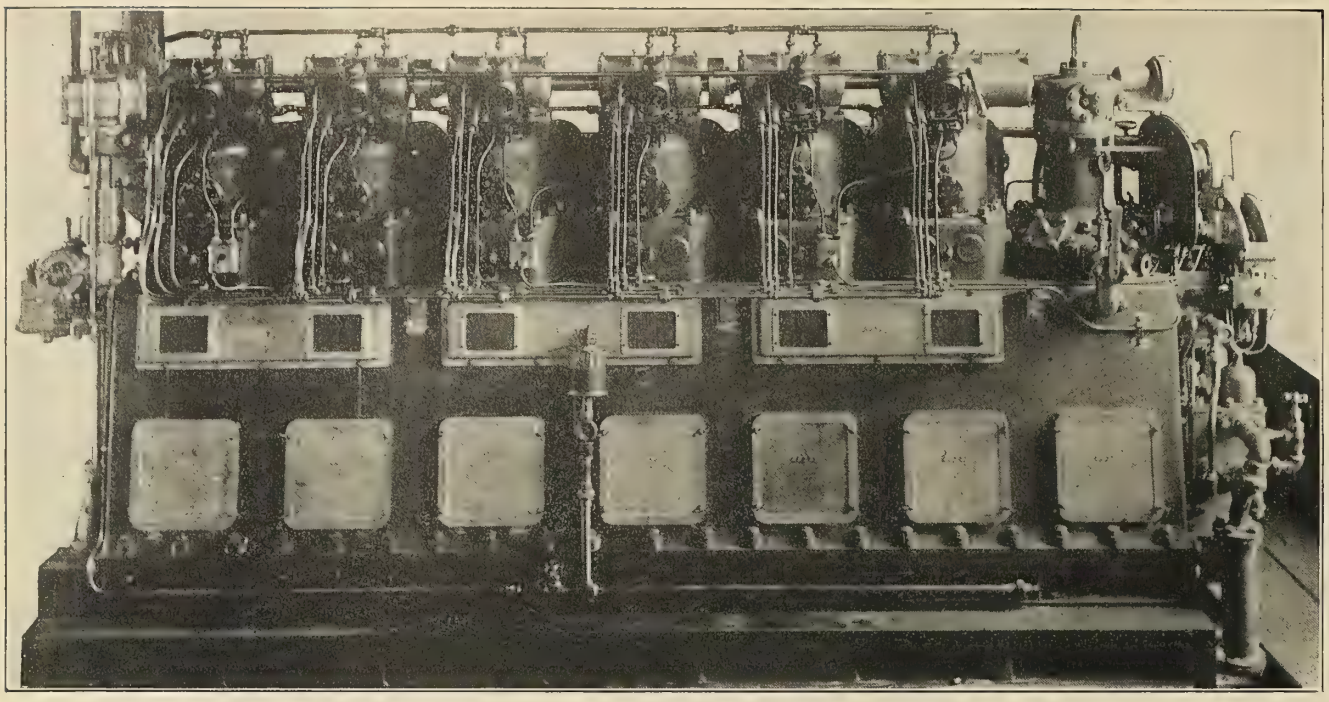


FIG. 4.—SIX-CYLINDER, 150-HORSEPOWER AMERICAN-NUREMBERG ENGINE INSTALLED ON THE IDEALIA

space for storage is provided, and in this compartment is also located a large storage battery, to be used as an auxiliary to the lighting system. The boat is finished throughout in bright mahogany and all fixtures and furnishings are of pleasing design.

There is a deck house forward over the dining saloon, with the steering station amidship immediately abaft. The *Idealia* is rigged with a pole signal mast, located between the deck house and the smokestack. The smokestack is comparatively large in diameter and, while not required for the type of engine employed, gives to the vessel the symmetrical appearance usually met with in yachts of this character. The smokestack serves a number of purposes—containing a muffler for the engine, the smokestack from the galley, and in addition serving as an engine room ventilator. Two boats are carried on deck abaft the smokestack. The anchor gear consists of an Elco electric capstan, with electric control located on deck. A powerful searchlight is mounted on the forward part of the deck house.

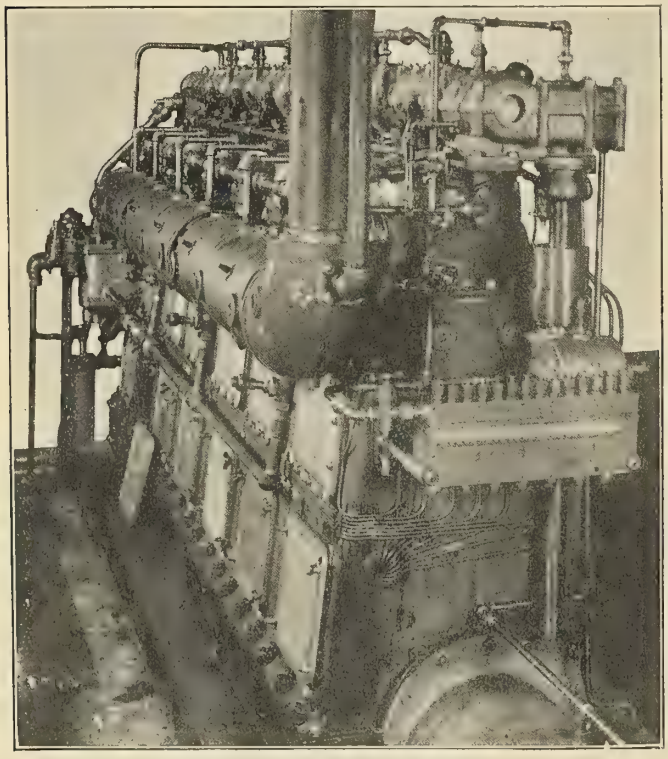


FIG. 5.—END VIEW OF IDEALIA'S ENGINE

The *Idealia's* engine is of the Nuremberg type, built by the New London Ship & Engine Company, Groton, Conn., and consists of six cylinders and one two-stage air compressor. It works on the two-cycle principle, and therefore has an even turning moment and does not require the use of a flywheel. A very efficient patented system of reversing is provided, whereby through the operation of a single lever the engine may be started, stopped and reversed with greater ease and quickness than are usually found in a steam engine of the same power. The maneuvering of the engine is accomplished by means of compressed air contained in steel flasks. With the supply of air carried the engine has been reversed over forty times in quick succession. In addition to the store of compressed air an auxiliary air compressor is provided, independently driven by a 10-horsepower oil engine, which may be started by hand, so that all danger of being unable to start the engine, due to lack of compressed air, is practically eliminated.

With the Diesel engine low grades of oil may be efficiently used and the thermal economy is very high. This gives the engine a great advantage over the gasoline (petrol) engine for units of this size and larger where the fuel bill is a serious item. An excellent way to appreciate this feature is to look into the question as it affects the *Idealia*. The *Idealia's* engine develops 150 horsepower at 550 revolutions per minute. The fuel consumption averages one-half pound per horsepower-hour, and the fuel oil costs from 3 to 5 cents (1½ to 2½d.) per gallon, depending upon the grade and the place where it is purchased. A gasoline (petrol) engine of corresponding power will use approximately 1 pint of gasoline (petrol) per horsepower-hour, the present price of gasoline (petrol) being about 18 cents (9d.) per gallon. At full power the *Idealia* makes about 14 miles per hour. From the foregoing data it is apparent that, using fuel oil, the radius of action of the *Idealia*, whose fuel tanks have a capacity of 450 gallons, is 630 miles, and the cost of fuel is only 2.167 cents (1.08d.) per mile. If

gasoline (petrol) were used the *Idealia* would be able to travel only 336 miles, and the cost would amount to 24 cents (1s.) per mile. In other words, taking gasoline (petrol) at 18 cents (9d.) per gallon, and fuel oil at 3 cents (1½d.) per gallon, the fuel bill of the *Idealia* will be only about one-tenth of a similar yacht equipped with gasoline (petrol) engines. The first cost of oil engines is naturally considerably greater than that of gasoline (petrol) engines. The difference in cost, however, can soon be made up by the saving in fuel bills for the distance traveled. The New London Company is now building a large number of engines of the same general type, ranging from 300 to 900 horsepower, and has plans available for various classes of oil engines of much greater power. Now that a start has been made with the use of Diesel engines for yacht purposes in this country, it is very probable that we shall soon see its extensive adoption in yachts of all sizes.

New Turbine Steamer for the Allan Line

The new turbine steamer *Alsatian* was built by Beardmore, Glasgow, for the British-Canadian service of the Allan Line Steamship Company. The turbines are of the Parsons impulse type, four shaft triple expansion, and the ship is propelled by four three-bladed propellers, each 10 feet in diameter. The chief particulars and dimensions of the ship are:

Length over all	595 feet.
Length between perpendiculars	570 feet.
Breadth molded	72 feet.
Depth	45 feet 6 inches.
Draft	28 feet 6 inches.
Displacement	25,000 tons.
Deadweight	3,000 tons.
Tonnage, gross	18,000.
Shaft horsepower	19,000.
Speed	19 knots.
Number of lifeboats	40.

On the port outer shaft there is one high-pressure turbine 7 feet 6 inches in diameter, and on the starboard outer shaft there is one intermediate-pressure turbine 8 feet 6 inches in diameter, while on each of the two inner shafts there is one low-pressure ahead and astern combined turbine 12 feet in diameter. The steam from the boilers passes into the high-pressure turbine, then over into the intermediate turbine, and afterwards through separate pipes into each of the low-pressure turbines. The exhaust steam goes direct into two steel plate condensers, placed at the after end of the low-pressure turbines.

The introduction of the intermediate-pressure turbine provides a much wider range for the expansion of the steam, and will effect a marked improvement in steam consumption as compared with the usual arrangement of turbines adopted in large merchant steamers and warships. The turbines and condensers are situated in one watertight compartment, together

ALLAN LINER ALSATIAN: DISPLACEMENT, 25,000 TONS; GROSS TONNAGE, 18,000; SHAFT HORSEPOWER, 19,000; SPEED, 19 KNOTS

with the main circulating pumps, dual type wet and dry air pumps, evaporators and distillers. The circulating pumps and air pumps form two separate sets, each working in conjunction with one condenser, but they are also arranged so that either set of pumps can work in conjunction with both condensers.

The turbine rotors are built up of steel forgings and the casings are of cast iron, each in two sections with a horizontal coupling.

The propeller shafting is of ingot steel 12 inches in diameter. A torsion meter is fitted to each shaft, indicating the shaft horsepower.

The boiler installation consists of six double and four single-ended boilers, each 16 feet 9 inches in diameter, the double-ended being 22 feet long and the single-ended 11 feet long. They are designed for a working pressure of 200 pounds per square inch and are constructed for the Howden system of forced draft, the air supply being maintained by an installation of electrically driven fans. The furnaces are of the suspension type, the total number being sixty-four. The exhaust gases pass away through two smokestacks, each 50 feet long and 18 feet in diameter.

Coal bunkers are provided at the sides of the boiler rooms, and there are also cross bunkers. The total bunker capacity is 2,500 tons.

The vessel has been constructed to the rules of the British Corporation for the highest classification of that society. She has eight decks—orlop, lower, main, upper, shelter, bridge, promenade and boat decks. The main deck is watertight. There are ten watertight bulkheads subdividing the ship, and they are watertight up to the underside of shelter deck. A cellular double bottom is fitted from the fore peak to the after peak bulkhead. The space between the outer and inner bottom is fitted to provide for 1,800 tons of ballast, 500 tons of fresh water for the ship's use and 400 tons of fresh water for boiler feed reserve. The keel is of the flat plate type and consists of two plates, each 1 inch thick. The shell plating ranges from 7/8-inch at midships to 5/8-inch at the bow and stern. The plating is for the most part double riveted. The after framing is bossed out around the propeller shafting, the shaft brackets being of the spectacle type. The stern is overhung for a length of about 80 feet—that is, the deadwood has been cut away. She has a round stern of the usual warship form, and the rudder is of the balanced type and hung from one pin on the stern post casting. The rudder is of cast steel in two sections, bolted together, and the rudder stock is 18 inches in diameter.

The steam steering gear is supplied by Messrs. Brown Bros., of Edinburgh, and is of the well-known rack and pinion type with auxiliary steam and hand gear. The gear is placed on the lower deck and is controlled from the bridge by telemotor gear.

The ship has two steel masts 30 inches in diameter, with four derricks on each mast. Marconi telegraph wires extend from masthead to masthead, and there is a Morse signal lamp on the fore mast truck. Lifeboats are provided for all on board. Sixteen wood lifeboats and eighteen semi-collapsible boats are stowed under davits, while six semi-collapsibles are stowed within reach of the derricks aft. The davits are of the ordinary pattern, but of steel tube, and the davit blocks are of Higginson patent non-toppling type. For hoisting and lowering the lifeboats, four electric winches are placed on the boat deck.

Ten silent-running steam winches of Wilson's patent are on deck for working the cargo. These winches have cylinders 8 inches by 12 inches, and are each designed for raising a load of 5 tons.

Stockless anchors, each 6½ tons, are stowed in cast iron hawse pipes, with chain cables of 3-inch stud links. There is one capstan and windlass for each cable. They are of Napiers make and each is worked by a vertical engine having a cylinder 18 inches diameter with 12-inch stroke. At the stern four warping capstans of Napiers type are placed on the shelter deck. Each one is driven by a vertical engine with 12-inch cylinder and 10-inch stroke. Three of Waygood's electric lifts are provided for passengers, stores and mails.

The *Alsatian* is fitted throughout with the Magneto Company's electric clock system, which consists of a number of Magneto secondary clocks distributed throughout the ship, all actuated by a centrally placed Magneto marine master clock.

For the 1,550 passengers and 575 members of the ship's staff there is excellent provision in the form of staterooms and saloon accommodation on the various principal decks, and there is also liberal provision for promenading and recreation. On the boat, or top, deck the clear stretches of deck afford a very fine run promenade. On the deck below there is the main promenade, sheltered from the sun, and also from the rain, by sliding windows forward, while there is another sheltered promenade on the deck below this.

The characteristics of the *Alsatian's* accommodations are space, air, light and ventilation. The Allan Line, after long experience, have adopted the Ashwell & Nesbit system of ventilation. The first class staterooms are arranged so that they can be booked separately, and many of the staterooms are connected so that they can be booked in series for families. In a number of staterooms only single berths are provided, and the great majority of the rooms are only for two passengers.

The various public apartments in the *Alsatian* are elegant in design and admirable as regards dimensions and proportions, the general scheme of decoration being chaste and subdued, the upper rooms, such as the reception hall, the lounge and the library being unconventional in respect of having bay windows and alcoves, which impart a general feeling of shore environment and comfort.

The *Alsatian* is designed to carry her cargo in five holds. The provision made for carrying perishable cargo is the feature of greatest interest in her cargo arrangements. The insulated holds are at the stern. The refrigerating machinery is supplied by the Liverpool Refrigeration Company, and consists of two compound duplex CO_2 machines, driving two double-acting CO_2 compressors, and each machine is capable of maintaining a temperature of 15 degrees F. in the insulated holds, which have a total capacity of 80,000 cubic feet. Air cooling is now being adopted when the maintenance of flavor is an important consideration, and for the transport of cheese, butter, apples, etc., 30,000 cubic feet of cargo space is fitted with brine pipes, while air drawn from the atmosphere is driven over the pipes by an electric fan, which supplies cool air at 15 degrees F. The brine is circulated on the cloud system by the horizontal duplex brine pumps.

The electrical installation of the *Alsatian* consists of three turbo-generators of 250 kilowatts each, placed in one compartment on the lower deck, and these have been supplied by the British Westinghouse Electric Company.

The doors in the main hold bulkheads have been fitted with the Stone-Lloyd system of closing, whereby they can all be closed in a few seconds from the navigating bridge. This system is worked by hydraulic power, two pumps being fitted in the main engine room for the purpose. From the pumps a pressure main pipe is led to a hydraulic cylinder fitted at each door. An automatic indicator is placed on the bridge and shows the position of each bulkhead door, whether closed or open.

The vessel is fitted with receiving apparatus for submarine signals on the system introduced by the Submarine Signal Company. She has also a 24-inch searchlight on the bridge.

The *Alsatian* is designed for a speed of 19 knots at sea.

McAndrew's Floating School

BY CAPT. C. A. McALLISTER*

"I suppose you have noticed that toy safety valve just over the uptakes on our boilers. If you didn't see the main safety valves, you might get the idea that the boiler designer had put a boy to do a man's work. The object of this little valve, which should always be a lever valve with a sliding weight, is to give warning that the steam is almost up to the blowing-off point; hence it is known as a sentinel valve. If for any reason the springs in the safety valve refuse to work, this little valve is sometimes very useful.

"You, of course, have heard of the blow valves on the boilers. These are usually fitted to all boilers; one is known as the 'surface blow' and the other as the 'bottom blow.' In boiling water the lighter impurities, such as grease and other

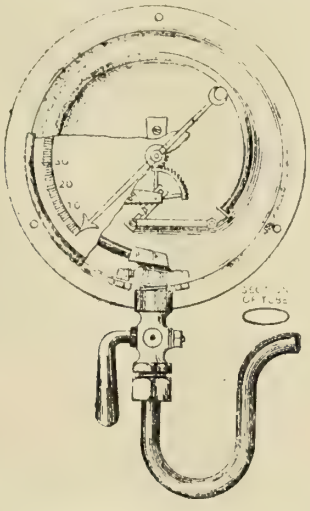


FIG. 3.—BOURDON STEAM GAGE

substances which float on water, are driven to the surface of the water. O'Rourke, I know, has often watched his mother skim the grease off the top of the boiling pot of soup, when he was a boy and was so hungry he could hardly wait for dinner time. The idea of the surface blow on a steam boiler is about the same, only in a boiler there is a pipe connecting the blow valve to what is known as a 'scum pan,' usually located in about the center of the boiler and at about the low-water level. At intervals it is advisable to open the surface blow valve and give it a slight blow in order to remove the grease and other floating impurities from the boiler water.

"The bottom blow valve is located at the lowest part of the boiler, and there is usually a perforated iron pipe connected to the blow valve. Mud and heavy impurities collect at the bottom of the boiler, and an occasional blow will remove such substances. This bottom blow is sometimes used to pump out the boiler when it is desired that it be emptied.

"One of the most important of the so-called 'boiler fittings' is the steam gage, for it is by means of this instrument that we are enabled to determine the actual pressure of the steam in the boiler.

"Fig. 3 is a picture of the type of steam gage usually fitted to marine boilers. By means of a circular tube having an elliptical section as shown, when the pressure is applied to the inside of the tube it tends to assume a round section, and the tube itself tends to straighten out owing to the greater area subjected to pressure on the outside surface. The free end of the tube is connected by gear wheels and pinions to the needle on the face of the dial which, when properly adjusted, records the steam pressure. Remember, as I have called to your attention before, boiler gages only record the pressure above the atmosphere and not the absolute pressure.

"Steam gages on boilers should be tested at intervals to see that they are adjusted correctly, as it frequently happens that gages on different boilers, all connected up, show a variance of from 1 to 10 pounds. I once had a green fireman with me who nearly broke his back trying to get the steam on his boiler up to the same pressure carried by the other boiler; as a matter of fact, the gage on his boiler recorded 5 pounds less pressure, due to its being out of adjustment. The older firemen let him hustle for a day or so before they told him the gage was wrong."

"Why do they always put that crook in the pipe to the steam gage?" inquired Nelson.

"That's because most water tenders are so used to seeing

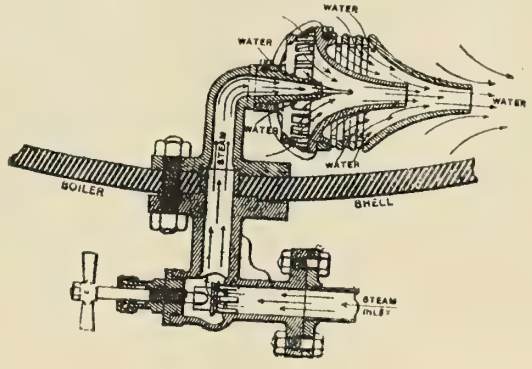


FIG. 4.—HYDROKINETER

snakes that they want things to look natural to them when they watch the steam gage," volunteered O'Rourke.

"O'Rourke is as nearly right as usual," replied McAndrew. "The real reason is that if the steam acted on the Bourdon tube direct, the expansion due to the varying temperatures would make it record inaccurately. Hence, the crook serves the purpose of a trap, as it fills with water by the condensation of the steam, and this water is forced into the tube by the steam.

"Another important fitting is the air cock, which is usually placed at the highest part of the boiler. When fires are started this cock should be opened in order that, as the steam is raised, all the air in the boiler will be driven out. It should not be closed until live steam issues from the cock.

"To impress upon you the importance of paying attention to even the smallest details around boilers under steam, I want to call your attention to a boiler explosion on board an American vessel not many years ago, when over thirty lives were lost and great damage was done because a fireman who was sent on top of the boilers to close the air cock not only closed that fitting but also shut off the cock in the small steam pipe which led to the steam gage. The result was that although no steam showed on the gage the pressure in the boiler rose to the bursting point and the explosion followed. Always remember that if you make a mistake like that you endanger not only your own life but the lives of everybody else on the ship.

"Some boilers are fitted with what is known as a 'hydrokineter,' which means literally a water heater.

* Engineer-in-Chief, U. S. Revenue Cutter Service.

"One of the great faults of all Scotch boilers is that the water under the furnaces and combustion chambers does not circulate properly, or, in other words, it is dead. The hydrokineter is usually located in this dead water, and when live steam is admitted it acts on the principle of an ejector and causes the water to circulate as indicated by the arrows in the sketch. I have seen boilers carrying over 100 pounds of steam when you could bear your hand on the bottom of the shell because of the presence of the dead water underneath the furnaces. Some engineers when raising steam will connect the auxiliary feed pump so as to draw this cold water out through the bottom-blow connection and discharge it through the auxiliary feed check valve, thus causing an artificial circulation. There are also several very good patented devices for bringing about this much desired circulation.

"Another item which might be classed as a boiler fitting is the so-called fusible plug which the law requires shall be fitted to the tops of combustion chambers and at other important parts of the boiler. This consists of a brass plug screwed into a tapped hole; the center of this plug is filled with a soft metal, such a Banca tin, which, when not covered by water, will melt and allow the steam to blow through the opening, thus acting as a safety vent."

CHAPTER VIII

Forced Draft

"Before leaving the subject of boilers, we will look into the matter of forced draft. Although this ship is not fitted with any system for that purpose, many other ships are, so it will be well for you to know about the various methods adopted.

"I have told you that air is just as important for combustion as coal itself. When fires are started in the furnaces the smoke and hot gases go up through the tubes and uptakes to the funnel or stack. You might wonder why they don't come back through the furnace and ash pit doors. The reason why they do not is due to what is known as draft, or the tendency to go up instead of down. Air when heated becomes less dense or lighter in weight, hence it is that at the furnace front and under the grate bars there is a tendency of the air to flow through and up. This tendency is due to the difference in weight of a column of cold air of the height equal to the distance between the level of the grates and the top of the stack, and the weight of a similar column of heated air of the same height. This difference in pressure or weight is usually very slight, but sufficient to cause enough air to flow into the furnaces to keep up a reasonable rate of combustion. In general, the higher the funnel the greater the difference in pressure, and consequently the better the draft.

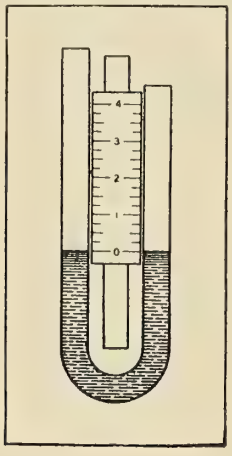


FIG. 5.—DRAFT GAGE

"Draft is usually measured by a device such as is shown in Fig. 5. One end of the U-shaped tube, which is located in the fire-room, is open to the air pressure in the fire-room, the other is connected by a rubber tube to the space under the grates. The difference between the two pressures compels the water to lower in the free end and rise in the end connected to the tube. We thus speak of draft as measured, not in pounds, but in inches or fractions of an inch of water. Were the pressure to be expressed in actual weight, such as a steam gage shows, you would find that 1 inch of water pressure would equal only two-thirds of an ounce.

"Ordinarily natural draft on a steamer of this size is about ¼ to ⅝ inch of water, and such a pressure under ordinary conditions is sufficient to burn enough coal to produce the desired speed of a vessel. There are times, however, when greater speed is demanded than can be produced by natural draft pressures. Fast passenger vessels, steam yachts and torpedo boats must go at full speed either all of the time or at intervals, and under these conditions a greater rate of combustion must be obtained. Hence it becomes necessary to use what is termed 'forced' draft, or in other words apparatus for furnishing a greater quantity of air to the furnace than would naturally flow in due to the difference in weight of the two columns of air.

"The most primitive system of forced draft is probably illustrated by the boy who, while shooting firecrackers, blows on a piece of punk in order to make the cracker fuses light easier."

"Chief," interrupted Schmidt, "I think we could have a good forced draft system on board this ship by making O'Rourke get on his hands and knees and blow under the grate bars; he's about as good a blower as I know of."

"That's all right," retorted O'Rourke, "about my forced draft; I know some one not very far off who couldn't be used for that purpose—he eats too much Limburger—his breath would put out almost any fire instead of making it burn faster."

"If you young men are running a debating club, we had better quit right here and let you fight it out," said McAndrew.

"Please go on with the forced draft, Chief," pleaded Pierce, who was by far the most earnest of the Floating School undergraduates.

"To return to the subject," continued the instructor, "forced draft on board steam vessels is produced by one of four general systems.

"The first and most generally used is the closed fire-room type, where all parts of the fire-room and boiler compartment are made as nearly air-tight as practicable, and the air is forced into the space by means of centrifugal blowers, which draw in the air from ventilators or sometimes from the engine room and discharge directly into the fire-room. As there is no other escape except through the grate bar spaces, the fires are forced by means of the greatly increased amount of oxygen available for the purposes of combustion. This system is more comfortable for the firemen, as the cooler air from outside makes the temperature lower. It gives, however, a somewhat uncomfortable feeling in your ears, as the pressure is, of course, greater than the ordinary pressure of the atmosphere."

"Why can't you put cotton in your ears?" inquired Nelson.

"You could if you wanted to, but the pressure would be on the cotton just the same, and there would still be a feeling of pressure on your ear drums.

"A steam jet in the funnel is another system of forced draft, and probably the simplest that can be devised. The most efficient jet seems to be one that is located right in the center of the stack, and so proportioned as to blow the steam out through a conical opening, causing it to spread out to the sides of the stack and creating a lowering of the pressure in the up-take, which causes a more rapid flow of the air through the fires. Steam jets are not very economical for marine purposes, as they waste too much valuable fresh water.

"On harbor boats or on vessels running in fresh water, they provide a simple and inexpensive forced draft. All steam locomotives use what practically amounts to steam jet forced draft, as you probably know that the exhaust steam from the two cylinders is turned into the stack, which with the engine at full speed produces a very strong draft.

"Ash pit draft is another of the four systems used. In this the air is led from blowers through sheet iron ducts, directly to the ash pits, where it is discharged underneath the grate bars. When it becomes necessary to charge the furnace with coal the draft must be shut off, else the flames and gases will be forced out of the furnace doors into the faces of the firemen. The best type of ash pit forced draft is where the air from the blowers is passed through a heater arranged in the up-takes, whereby some of the heat which would otherwise be lost in the escaping gases is utilized in warming the air which is used for combustion.

"Induced draft is used on many vessels; this is caused by locating a large blower at the base of the stack, which draws the gases from the up-takes and discharges them higher up in the stack or funnel. This is much less expensive than the closed fire-room system, and in case of any leaks in the breeching or up-takes the air from the outside rushes in, and thus prevents the escape of gases into the fire-room space, as frequently occurs when natural or forced draft of the other types is used.

"This will close my remarks on the subject of boilers, and as O'Rourke has fallen asleep twice in the last ten minutes, I think you had all better 'turn in.'"

CHAPTER IX

Engines

On the following evening McAndrew began his lecture by saying:

"Young men, we are now about to take up a subject which I know will interest you greatly, as you all hope to be engineers; that is, men capable of running and caring for engines.

"O'Rourke, what, in your opinion, is an engine?"

"Let me see," replied the spokesman of the class. "An engine is something that makes the wheels go around."

"You're right," replied McAndrew; "shorn of all qualifying verbiage that is really what it does, and that is its principal function. But how does it do it? that's the question. You all know that when everything is in readiness the man on watch opens the throttle and the screw begins to revolve. If that was the extent of your knowledge you would be simply engine starters and stoppers, but I trust you will know more about it before you get your licenses.

"As I told you before, if a cubic inch of water is turned into steam the latter would, under atmospheric pressure, expand into almost a cubic foot of steam. When, however, it is confined in a steam-tight vessel such as a boiler, it cannot expand into such a large volume, and consequently the pressure rises. When it reaches, say, a pressure of 180 pounds per square inch, it has a tendency to expand into the volume which it would occupy if all pressure were removed. It is this tendency to expand which makes steam valuable as a source of power, and the greater the pressure the greater the expansion. In this connection you should remember the fundamental rule that the pressure multiplied by the volume is always equal. Thus if we have one cubic foot of steam at a pressure of 100 pounds per square inch, it has the same expansive effect as would 10 cubic feet of steam at a pressure of 10 pounds per square inch.

"When steam is released from the boiler and enters an engine, it tends to expand like a compressed spring if the weight is taken from it. When it reaches the cylinder of an engine through the pipe connecting the boiler to the cylinder it starts to expand, and as the sides of the cylinder and the cylinder head are fixed and rigid, the only way it can increase in volume is to force the movable piston in the cylinder up or down as the case may be. This up and down motion of the piston is transmitted through the piston and connecting rods of the engine to the crankshaft which rotates and turns the propeller.

"There have been numerous kinds of engines invented to utilize the expansive force of steam, and step by step they have been improved upon, until now practically nine-tenths of all the marine engines in use are of the vertical, inverted, triple and quadruple expansion types and the more recent type known as the turbine. Obsolete types, or those which have outlived their usefulness, are of interest to show what steps have had to be taken to reach the present standards, but for your purposes the modern engines are those to which you should devote most of your attention.

"Nelson, what is your definition of a triple-expansion engine?"

"One that has three cylinders, sir," he promptly replied.

"That is true in part," said McAndrew, "as the majority of triple-expansion engines do have three cylinders; but I want to disabuse your mind of the idea, which so many youngsters seem to have, that the number of cylinders determines the type of the engine. Some compound engines have three cylinders, some triple-expansion engines have four and even five cylinders, so you see that your definition does not hold in all cases.

"Engines derive their classification or type from what we may call the different stages in which the expansive effect of the steam is utilized. A simple engine is one in which all of the expansive effect is utilized in one stage; a compound engine is one in which this is accomplished in two stages or periods; a triple expansion type is one in which it takes three stages of expansion to get all the work from the steam. Thus if we are using steam at 180 pounds gage pressure in the high-pressure cylinder (or first expansive stage) it partly expands during the first step to a pressure of, say, 60 pounds, when it is exhausted into the second stage, or the intermediate cylinder, as it is termed; there the expansive force is reduced to, say, 10 pounds gage pressure, when it again passes to another stage, or the low-pressure cylinder, in which it is expanded down to an absolute pressure of perhaps 2 pounds, depending upon the vacuum carried in the condenser. The whole process might be compared to wringing the water out of a tablecloth.

"Now, O'Rourke, I suppose when you were a boy you have helped your mother with the family wash on Mondays, haven't you?"

"Sure thing," he replied, "whenever I couldn't stick my kid brother on the job."

"Well, you might remember that your mother would take a tablecloth out of the bluing water and give it a twist, thus rinsing out considerable water; after a while she picked it up, took hold of one end of it while you took the other end, and you both twisted it as hard as you could, with the result that more water came out of it. Finally, she put it in the wringer, for which you probably furnished the motive power, and still more water ran out of it. Well, that's the idea of a triple-expansion engine; it takes three processes to get the work out of the steam, just as it took three processes for you to get the water out of that tablecloth."

"Gee!" said O'Rourke, "I must have been a triple-expansion laundryman and didn't know it!"

"I think from the sound of the hot air which escapes from him he must have been a simple one," volunteered his rival, Schmidt.

"Having, I hope, fixed in your mind the idea of a triple-expansion engine, we will now investigate some of its parts. The cylinders, naturally, are the most important of these, as in them the work of the steam is performed.

"I suppose you know that the name comes from the geomet-

rical figure known as a cylinder, as the inside or working surface of the so-called cylinders is perfectly cylindrical; that is, it is exactly circular in section at any point. The outside of a marine engine cylinder is anything but cylindrical, owing to the valve chests, flanges, etc., necessary to fit it for its work.

"All steam engine cylinders are made of cast iron, because that is the ideal material for the purpose; no other material would fulfill all the requirements.

"The thickness of cylinders depends upon several things, the most important of which is the strain which it is required to withstand. However, you will find that they are always made much heavier than actually necessary, as all parts of machinery are, when designed, given what is termed a 'factor of safety.' That is, after you have calculated how thick any part should be from a theoretical standpoint, you make it actually three, four or even five times as thick, then you will be deadsure that you are on the safe side. You might think from that statement that designing engineers do not have much nerve, and as a matter of fact many of them are lacking in that essential. Experience has, however, taught them to be on the safe side, for in marine machinery particularly emergencies develop in the most unusual way at times which upset all theories. After cylinders have been in use for a number of years they may become badly scored or out of round, in either of which cases it is necessary to have them rebored. Consequently the designer must keep that contingency in mind when determining the thickness. You can always cut off portions of a casting, but you can rarely add anything to them, hence they should be heavy enough at the start.

"Attached to and cast with the cylinders are the valve chests which contain the valves for regulating the entrance and exit of the steam to and from the cylinders. They vary in size and shape in accordance with the type and sizes of valves used.

"The cylinder heads are, of course, a necessary adjunct to close up the tops of the cylinders. Relief valves are always fitted at the top and bottom of each cylinder to relieve any steam pressure in excess of the safe working pressure, but principally to relieve the cylinders of water pressure, in case, as may happen, water collects in the cylinders, either from being carried over from the boilers with the steam or from being condensed in the cylinders before they are properly warmed up. Water is, as you may have observed, practically noncompressible, so that if any collects either at the top or bottom of the cylinder, and the piston moves rapidly against it, something must give way. The relief valves, if properly adjusted, serve the purpose of allowing the water to escape and of preventing an accident to the head or to the cylinder itself."

(To be continued.)

United States Battleship Pennsylvania

Battleship No. 38, of the United States navy, to be named the *Pennsylvania,* was authorized by Act of Congress, approved Aug. 22, 1912, which stipulated:

"That for the purpose of further increasing the naval establishment of the United States, the President is hereby authorized to have constructed one first-class battleship, carrying as heavy armor and as powerful armament as any vessel of its class, to have the highest practicable speed and greatest desirable radius of action and to cost, exclusive of armor and armament, not to exceed $7,425,000 (£1,525,000)."

The usual plans and specifications of the vessel were prepared by the Navy Department. As is customary, and in order to carry out the provisions of the above Act, and to take advantage of all possible improvements existing in the construction of a ship such as contemplated by the Act, the Department, in advertising for bids for the construction of this vessel, invited proposals under two classes, viz.:

Class 1. For the construction of the hull and machinery on plans and specifications provided by the Secretary of the Navy; the installation of reciprocating engines and watertube boilers, fitted for burning fuel oil, being the principal features of construction with respect to the machinery.

Class 2. For the construction of the hull, for the equipment, the installation of ordnance and ordnance outfit and armor in accordance with plans and specifications furnished by the Secretary of the Navy, and for the construction and installation of the propelling machinery and its auxiliaries, the boilers to be fitted for burning fuel oil and the propelling machinery and auxiliaries to be in conformity with the *bidder's* design.

Specific guarantees of the total fuel-oil consumption per knot at contract speed and at speeds of 19, 15 and 10 knots were required.

Bids for the vessel were opened at the Navy Department, Washington, February 20, and the award of the contract for the construction of the vessel was given to the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., on their proposal under *Class* 2, the contract price being $7,260,000 (£1,490,000), and the time of building 36 months. The main particulars of the hull are:

Contract speed	21 knots
Length between perpendiculars	608 feet
Breadth molded	97 feet
Draft	28 feet 10 inches

The distinguishing features of the design above the deck are the two military masts, one smoke-stack and fore-and-aft turrets, each equipped with three 14-inch guns. In the subdivisions below decks cofferdams surround all the fuel-oil tanks as a means of protection and safety.

Propelling Machinery

The propelling machinery will consist of an improved type of Curtis turbines placed in four watertight compartments, the turbines operating four shafts and propellers. The characterizing feature of the turbine installation proposed will be found in the arrangement of gearing in connection with cruising turbines to be used under cruising conditions. For purposes of disconnecting the cruising outfit, when running at higher speeds, a clutch is provided in the shafting between the main low-pressure turbine and the gear shaft.

In the arrangement of the turbines there are placed on the inboard shaft the main high-pressure turbine in the forward engine room and an independent backing turbine in the engine room located immediately aft of the forward one.

On the outboard shaft, in the forward engine room, is placed the reduction gear casing with the two cruising turbines, each of which connects with a pinion engaging with a large central gear. At 1,800 revolutions per minute of the cruising turbines the gear revolves 120 revolutions per minute. The main low-pressure turbine, with its ahead and astern elements, is placed in the after engine room, an extension of the rotor shaft connecting with the reduction gear.

When running at cruising speed, steam is admitted as follows: First to the high-pressure cruising turbine, then to the low-pressure cruising turbine with driving gear attached to the low-pressure turbine, then to the high-pressure main turbine driving the inboard shaft, and finally to the low-pressure main turbine driving the outboard shaft. All propellers turn outboard for ahead motion.

The usual auxiliaries consisting of condensers, main and auxiliary air pumps, feed tanks, main circulating pumps, feed heaters, etc., are located in the engine rooms. The vacuum to be maintained under full speed conditions is to be 1 pound below perfect vacuum of the prevailiing barometric pressure.

Forced lubrication, together with water circulation in the rotor journals and the horse-shoes of the thrust bearings, is provided.

Boilers

There will be installed twelve watertube boilers, in which the diameter of the tubes is not to exceed 2 inches. The boilers will be designed for burning fuel-oil by mechanical atomization in the burners. The burners will be of the Bureau of Steam Engineering type. The fuel oil system will consist of the necessary pipe systems, light and heavy service pumps, tanks, strainers and oil heaters. For control of operation there will be oil meters in the suction pipes, gears for operating fuel-oil valves and level indicators placed near the storage tank manifold. Hand pumps capable of delivering air to a few of the burners at 200-pound pressure, when the boilers are cold, form part of the equipment.

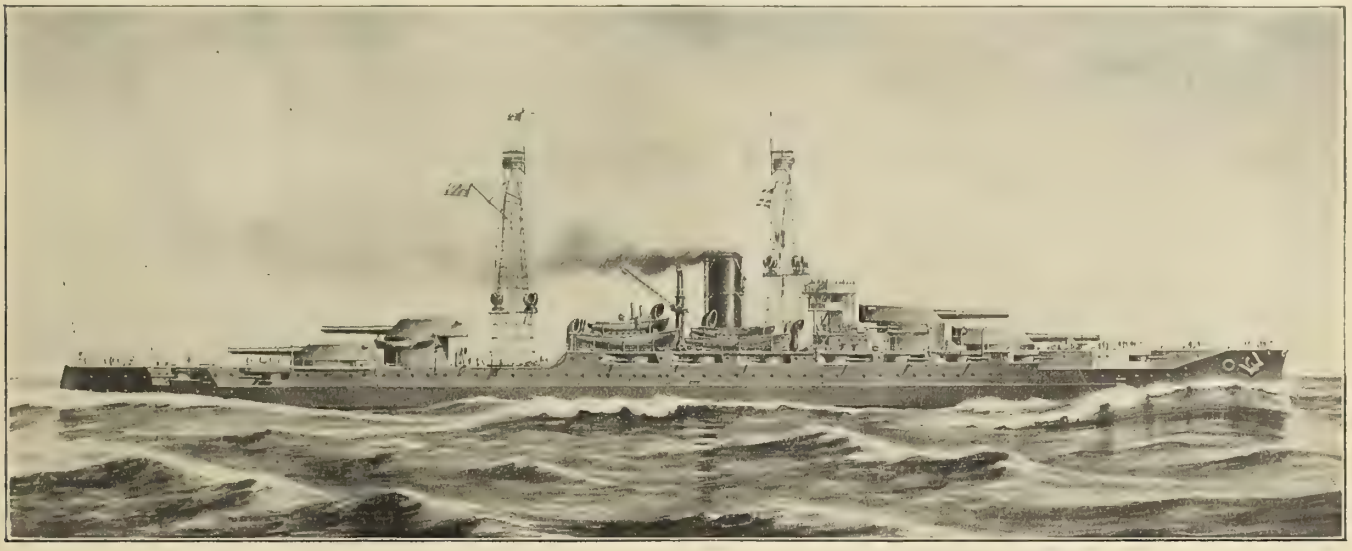
Air for combustion is furnished by forced draft blowers, the mixing of the air and the atomized oil taking place within the furnace of each boiler.

The steam pressure at boilers will be about 295 pounds gage, while at the turbines it will not exceed 265 pounds. The total shaft horsepower will be about 32,000 at 220 revolutions per minute.

The four-shaft turbine arrangement in the ship in question is a singular departure from prevailing customs with the Curtis turbine for marine use, where either two or three-shaft arrangements have been the rule. The former was used in the *North Dakota* and in all of the torpedo boat destroyers, the latter in such ships as the Argentine battleships *Rivadavia* and *Moreno* now building in this country.

A comparison between turbine and reciprocating engine installations for a ship like the one forming the subject of this article will show the diameter of the screws for the former to be 13 feet against 21 feet for the latter, the diameter of shafting 12.5 inches against 20.5 inches, the stress on the shafting 6,500 against 9,500 pounds per square inch of section, etc.

Considering the expected improvements in economic performance, both at full power and under cruising conditions (as due to better turbine arrangement, more efficient screws when the turbine power is divided among four screws as compared with two or three screws in former ships, and the geared cruising turbines), the growing tendency towards larger and speedier ships and the tactical advantages existing in the uniformity of ships, when in squadron, it seems quite in keeping with the progressive policies adopted by the navy to have accepted the contractor's proposition to install turbines in place of reciprocating engines for the propelling machinery of this latest, most modern and powerful dreadnought.



THE UNITED STATES BATTLESHIP PENNSYLVANIA AS SHE WILL APPEAR WHEN COMPLETED

(From *Scientific American*)

The Fuel Oil Situation

The action of the producers of fuel oil four months ago in practically withdrawing that product from the market is leading to the rapid development of substitutes with the necessary apparatus and methods. Until quite recently, after the extraction of the several grades of gasoline (petrol) and kerosene (paraffin) from the petroleum, the residue was considered as a by-product, valuable as fuel, also for the treatment of roads and some other purposes, and the cost to the consumer was low. The immense increase in the use of gasoline (petrol) has made it profitable to extract the residual naphtha from the fuel oil, and that fact accounts in part for the present attitude of the producers. Many plants are equipped to use oil as fuel in furnaces and forges, under boilers and for other purposes. Now the experts in the various substitutes are putting forth their best efforts in the attempt to give equally good results, and they are developing refinements which should be of great industrial value.

The heavier Mexican oil, of which the supply is enormous, is being used with some success in a modified type of apparatus, and promises to occupy a prominent place in the future. Common illuminating gas and producer gas are taking a more important place. That they contain sulphur has been, of course, an objection to their use in some metallurgical processes. But open-hearth furnace operations have long been based on gas producers, proper care being taken that the coal is low in sulphur, with all due precaution against "cold" gas and sluggish working of the furnace. In the various forms of heating furnaces and in the heat treatment of steel gas is used to an increasing extent. Welding has been done successfully, it is stated, using gas from a city main, containing the usual percentage of sulphur.

One theory of the present situation in fuel oil is that as soon as market conditions have driven large users to other fuels it will again be available to some of its present consumers in metal-working lines. The attempt now is, apparently, to reduce certain of the channels of consumption to the lowest possible point.—*The Iron Age.*

Engineers and Shipbuilders' Summer Meeting.—The Institution of Engineers and Shipbuilders in Scotland and the Institution of Naval Architects have arranged a joint summer meeting, which is to be held in the rooms of the Scottish Institution, Elmbank Crescent, Glasgow, on June 24, 25, 26 and 27.

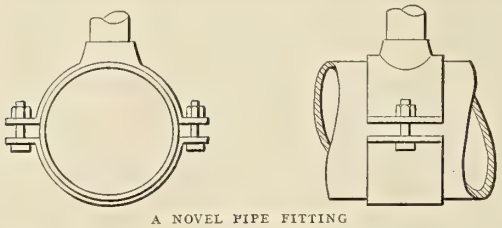
Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

How a Little Difficulty Was Overcome

We had a 4-inch water service pipe that carried 30 pounds pressure, and it was necessary to lead a 1-inch pipe from same to an air compressor for cooling water, but the water service pipe had flanged joints and was too thin to tap for a pipe thread. Furthermore, there was nothing on board that could be used so that a valve could be installed. It was finally suggested that a fitting be made as shown in the sketch.

The blacksmith made a band in two halves, leaving a boss on one large enough to take the inch pipe. This was bolted together with distance pieces between lugs, and bored to fit the



A NOVEL PIPE FITTING

water service pipe, and the boss was drilled and tapped. Then it was fastened on the 4-inch pipe with a red lead joint, and the tapping drill put through the pipe and the hole tapped. The nipple was made long enough to screw through the boss and pipe.

This made a very strong job, and answered its purpose so well that it has never leaked a drop since it was put up, and that was over five years ago. From appearances I should say that it will outlast the pipe. I have seen many pipes strapped to stop leaks and to strengthen weak ones, but I have never before seen a new lead taken from a pipe in this way. As it was new and a handy contrivance to me I felt that it might help others. Reader.

Breaking Gage Glasses

A few years ago I was an assistant engineer in a vessel plying between the States and small Mexican seaports. One trip, after spending some little time in a shipyard, we put out to sea, but were continually annoyed by having the main boiler gage glasses break. A glass would last about three or four hours, often less. Not carrying a large supply in our stores, we soon found ourselves with about four left, and having at least two weeks ahead of us before we could renew our supply, we began to look for the cause, as the same brand of glass had given satisfactory service before.

The fitters in the shipyard had put up a new water column on the starboard boiler, which was the boiler that was giving all the trouble. On examining its water glass connections, we found the top one quite out of line with the bottom one.

At the risk of breaking it off, we used a large Stillson wrench and managed to turn it, thus bringing both connections in line. But, being shy of main boiler gage glasses, and having a good supply of donkey boiler glasses, the chief engineer devised a plan to use the smaller glasses till we got home. Having some brass pipe on board, the outside diameter of which was the same as that of the main boiler gage glasses, we cut lengths of this pipe which, in addition to the short donkey boiler glasses, would equal the required length of a main boiler glass.

We cut threads on one end of these pieces of pipe and screwed on part of a union with the nut. Our donkey boiler glasses just fitted inside the union nut, for which we cut several washers from ¼-inch canvas insertion packing. The lower nut being too large for the donkey boiler glass, we cut washers for each out of ⅛-inch sheet brass, whose outside diameter fitted inside of the nut and whose inside diameter just fitted the donkey boiler gage glass. We put the device in place, setting up the top nut with usual washers on the brass extension piece and then fitting the gage glass in place, setting up the nuts in the usual manner.

This device worked without mishap. I do not think we even renewed the original glasses on the voyage home. As the glasses were small, we were very careful to see that they did not choke and thereby risk dropping or heating our combustion chamber top. P. R. S.

Some Repairs to a Side Wheel Steamer

When the *P. S*—— was docked for her annual overhaul it was discovered that one of the paddle shafts had developed a crack in the wing journal as shown at *A* in Fig. 1. This is no unusual occurrence in side-wheel steamers and seems to be due to the overhang of the paddle wheel.

It was decided to remove the faulty shaft and replace it by another. With this object in view we proceeded to remove the crank web, as this was to be used in the new shaft. The

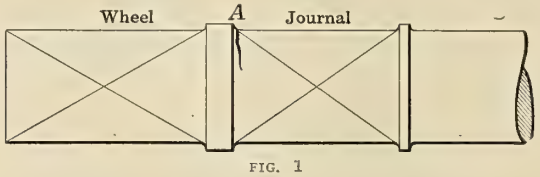


FIG. 1

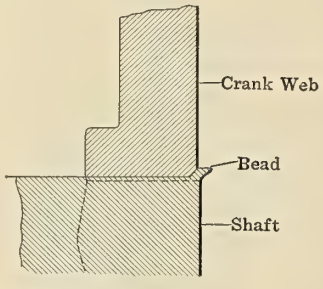


FIG. 2

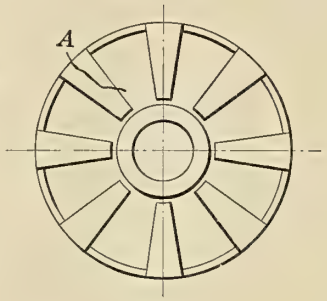


FIG. 3

usual method is to up-end the shaft with the crank end on the ground, build a mold round the crank boss and run in molten cast iron so as to expand the eye. If the crank is now tapped with a heavy hammer it will come off, but this case proved the exception to the rule. In spite of repeated heatings and hammerings, assisted by much profanity, the crank refused to budge.

This continued throughout an afternoon, at the conclusion of which an inspection was made, when it was discovered that the shaft was *riveted over* and finished off with a neat little bead in the manner shown in Fig. 2. This is a most unusual method of fixing a crank web to a shaft, and the only

theory to account for it is that it was originally done to hide a bad shrink.

The crank was eventually removed by boring out the shaft as shown by the dotted lines in Fig. 2 and machining away the bead and countersink. At this juncture an apprentice discovered that the paddle center was cracked as shown at *A* in Fig. 3. The crack seemed to have been caused by the hammering in of the paddle arms. The superintendent said that we had caused it, and, as it had been decided to fit a new center, to set all doubts at rest the center was broken by being struck near the crack with a "dolly." It was found that the crack had been there months, if not years.

The owners were in a hurry to get the steamer on her run, so the new center had to be made as quickly as possible. The making of the pattern occupied three days and nights almost to a minute. The center was cast and machined and the arms fitted complete in twelve days and nights more, making the total time on the job of a fortnight and a day, which is, I think, a record for this side of the "herring pond." It would be interesting if any reader could bring forward an account of a similar performance.

Scotland. "Ison."

More Comment on the Possibilities of the Oil Engine

Kindly allow me a little space in your publication to comment on the article by Mr. J. F. Wentworth, dealing with the "Possibilities of the Marine Oil Engine," which appeared in the March number.

Mr. Wentworth mentions a new method, devised by himself, to obtain the necessary temperature to ignite the fuel oil in a Diesel engine by preheating the air and thus obtaining the required temperature at a lower pressure, say 250 pounds per square inch, instead of 500 pounds. As a matter of fact, this method is not new. It has already been used by several builders in Europe, such as Ing. P. Kind & Company, of Turin; Gasmotoren-Fabrik, Deutz and Aktiebolaget Diesels Motorer, Stockholm, and is called a semi-Diesel cycle, in which the air is preheated for exactly the same reason as Mr. Wentworth exposes. The only difference is in the method of preheating. In the Wentworth method air is preheated by external means. I do not know the nature, but it is evident that another source of heat must be provided, as Mr. Wentworth makes manifest a personal grudge against the hot bulb.

In the semi-Diesel engines above mentioned the air is preheated by the air of a hot bulb. It is evident, then, that the hot bulb's function is to raise the temperature of the air and not to iginite the fuel, as in the low-pressure bulb engines in which the fuel is sprayed against the hot bulb itself or an appendage therefrom. Soot is a deposit of burned, or partially burned, particles of oil in which there are particles of liquid oil or moisture. Soot, as Mr. Wentworth tries to make us believe, does not deposit against the hot bulb, as its temperature would prevent it from remaining soot. What deposits against the hot bulb is only a layer of baked particles of fuel or residual carbon, the presence of which would not hinder combustion very much. As a matter of fact, a well-designed hot bulb is fouled very little, and in a semi-Diesel engine it should keep at a white heat surface continuously.

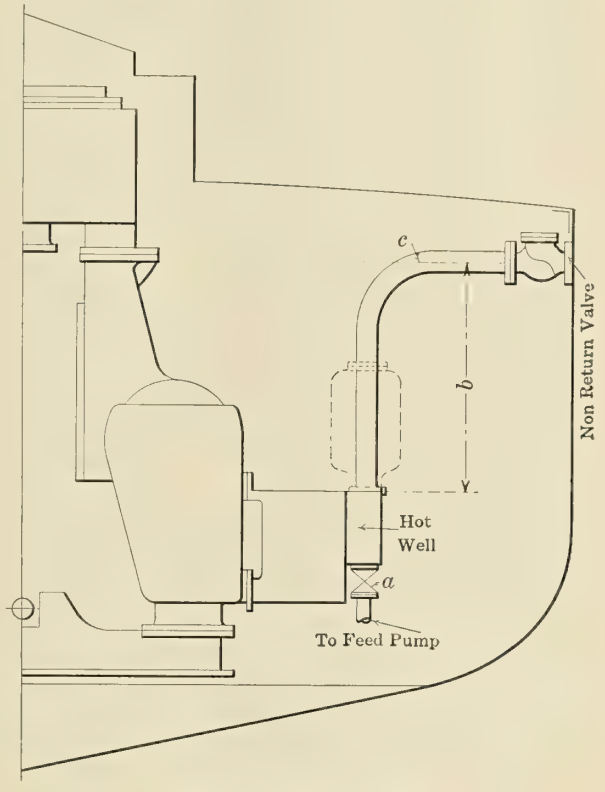
Hence both methods will give the same results as far as raising the temperature of the air is concerned. The real merit of any one method lies in its thermal efficiency. It seems to the writer that an outside source of heat entails an additional supply of heat units, and consequently losses in an apparatus that certainly cannot be 100 percent efficient. The heat supply should be added to the heat supplied by the fuel in the engine itself, and the heat utilized and transformed into energy should be, in percentage of the heat supplied, the theoretical thermal efficiency of the system. The hot-bulb method does not require an outside source of heat, as it is only heated once, and the heat is maintained by the fuel combustion, hence the thermal efficiency of the latter system should be higher.

The writer invites from Mr. Wentworth a thermo-dynamical analysis of both methods to show whether his (the Wentworth method) is the more efficient one or not.

Quincy, Mass. J. Barraja-Frauenfelder, M. E.

Difficulties with a Waste Pipe

The water from the air pump of surface condensing engines is mostly led to an oil filter, from which it is drawn away by the feed pump; and in small engines directly to the feed pump. A pipe from the top of the air pump connects the hot well to the vessel's skin, and through this pipe the air from the condenser will escape. On the skin in this connection is fitted a non-return valve, preventing in a seaway the sea



ARRANGEMENT OF WASTE PIPE

water from entering the pipe, so that it is impossible for salt water to mix with the feed water. For small engines this valve is nearly always a common steam valve.

On the small tug *E*—— such a valve was fitted. When the engine made her first revolution at the works all was well, but the water from the condenser was all pumped overboard, the feed pumps drawing the feed water from the river. This was always done with new engines, as with those very much oil and grease is used, so that a large quantity of oil would be pumped into the boiler. But afterwards it was preferred to use the water from the condenser for feeding the boiler, the cock, *a*, at the bottom of the hot well was turned on. But now it was seen that the feed pump could only pump a small part of the water to the boiler, as the greatest part was discharged with the air overboard. The cause of this was soon understood.

In the sketch the air pump, etc., are shown. The distance, *b*, from the top of the hot well to the pipe was only 2 feet. With up-going pump bucket the air was discharged through pipe, *c*, overboard and at the end of the upstroke a partial

vacuum was formed in this pipe by the rush of the air as the non-return valve closed after the air column had been set to rest. By this partial vacuum the water in the hot well would rise into the pipe, *c*, and with the following upstroke of the air pump bucket it was discharged overboard. As such small engines with a larger hot well and longer waste pipes had never given any trouble, it was thought desirable to enlarge the space between the top valves and the discharge valve. This was done by fitting a large air vessel as indicated in dotted lines. It was thought that the partial vacuum would be much less, so that the water could not rise into the pipe. In fact, after the fitting of this air vessel, no further trouble was experienced. D. K.

Loose Dowel Pin in Crank Shaft

During my career as a marine engineer, many and varied were the accidents and breakdowns that occurred to the main engines and boilers. One I remember above others, as, had the defect not been discovered and remedied when it was, a total breakdown would have been imminent. I refer to the dowel pin in the afterside of the low-pressure crank pin becoming slack and gradually working out.

For the benefit of those readers who do not quite grasp what a dowel pin is, I will briefly explain:

First the crank pin is shrunk into the web, which is usually bored out one sixty-fourth smaller than the pin, then heated until it expands large enough to allow the pin to enter into its correct position, and cooled down. After this a hole is drilled midway between the web and the crank pin and to a depth of about two-thirds the thickness of the web. Then a pin is made to drive into this hole, making a good tight fit (for a crank pin of 16 inches diameter, the hole is 1 inch diameter). This pin is known as a dowel pin.

On this occasion the fourth assistant engineer was relieving me, and as usual went the rounds of the engine and boiler rooms, to satisfy himself that everything was in order before taking over the watch. When he arrived at the after side of the low-pressure main bearing No. 6, he let out a big war whoop. The dowel pin had come out some way beyond the surface of the web, and in feeling the main bearing the crank came round and the pin caught his hand on the back and laid it open, necessitating his laying up for the remainder of the voyage of four weeks.

The engines were *immediately* stopped, the turning engine placed in gear, and the crank brought to the top center. We found the dowel pin had slacked out ⅜ inch. Had it come out much more the damage would have been serious, as there was very little clearance between the engine framing and the crank web.

We drew the pin, which seemed to be very slightly tapered, and found the crank pin itself loose in the web. The space between the web and crank was thoroughly cleaned out by squirting in kerosene (paraffin) oil, and small strips of thin tin were forced into the space all around the crank pin. These strips were about ⅛ inch broad by 5 to 6 inches long. We redrilled the hole, making it slightly larger, and made a new dowel pin on a small lathe we fortunately possessed in the tunnel, and drove this pin down good and tight with a "dolly."

To insure doubly against further delay and accident, we drilled another hole the size of the original dowel pin in the forward side of the same crank pin and web in a similar position, and drove another pin, which made a good solid sound crank pin once more.

The breakdown occupied considerably the best part of all night, as drills had to be made and the drilling done by ratchet, but the ship was not delayed very much. The vessel was a twin screw steamer and, as is usual on such occasions, we forced the good engine and made up partly for the disablement of the other one.

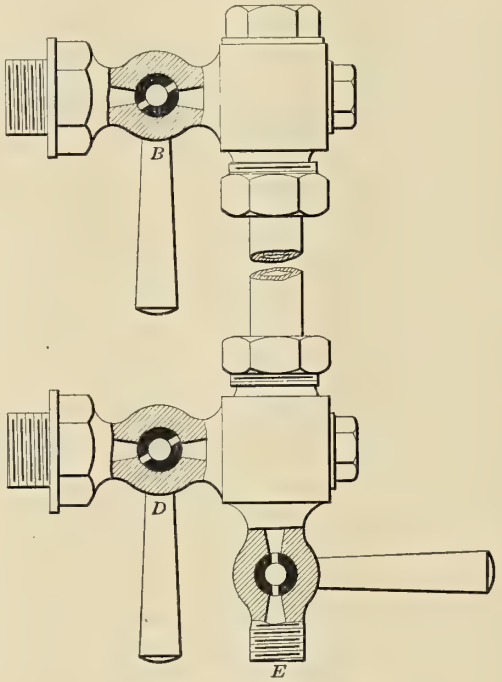
Several theories were advanced as to the reason of the above accident. My own opinion is that the thrust bearing was slack in its seating. We found this to be the case later, and consequently the longitudinal stress was taken by the crank shaft and tended to throw a greater stress on the working parts, particularly the big or bottom ends of the connecting rods, and also the main bearings; thus the crank was forced forward and the engines were thrown out of line, and when reversing took place the throw was in the opposite direction. The constant backward and forward stresses on the web loosened the crank pin and resulted in the above trouble.

Woodbridge, N. J. F. C.

Water Gage Fittings

The above in a steamer's engine room are possibly the most important fitting carried. Almost all seagoing engineers have had minor troubles concerning them, and neglect of their general well being brings sure trouble in a very short space of time.

Where the gage glass is mounted on a column with connecting piping to the lower part of the boiler and to the steam space respectively, care is necessary to insure that the water end of the piping does not become furred up. Instances have come under my observation where the cross sectional area of



GAGE GLASS ATTACHMENTS

actual water passage has been reduced to ¼-inch diameter and even less by furring up. The water in the lower limb is quiescent and at rest—ideal conditions for the formation of soft scale.

It cannot be too strongly insisted upon that this lower range of piping should come down every six months for thorough cleaning. Sometimes these pipes are fitted with oval flanges not stiff enough for an effective joint. Oval flanges from bitter experiences should, in my opinion, be barred for high-pressure steam, always forming an everlasting sore place in the engine room.

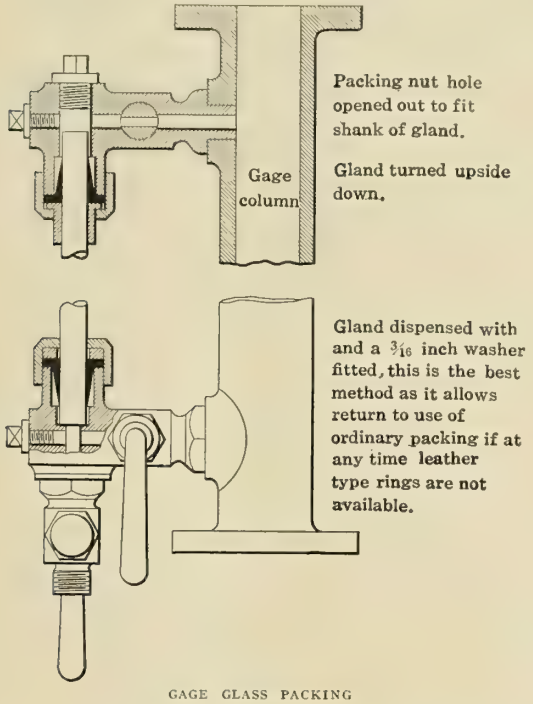
Engineer candidates for British Board of Trade certificates get severely handled over the question of blowing through the water gage, and in the examination room is provided a full size set on which every candidate, without exception, has to perform.

A misleading water gage is worse than useless, and cas-

ualties have happened owing to the handles of the cocks having been twisted relative to the openings through the gage. The sketch shows this by no means unusual defect.

A possibility to be borne in mind by all engineers is the blanking off of the steam space by the use of too long a glass, and so leading to a false level. Of course all the old hands are aware of this possibility, but it is worth notice in passing.

I do not know if the type of packing similar to a hydraulic leather is as well known as it deserves to be in America. Those sold here are of a patented composition similar to hard rubber in appearance. Gage glass mountings fitted for ordinary packing can be easily modified to suit this type of packing by the alterations shown in the sketch. The advantages of this type of packing are manifest. No spanner for nuts is needed, nor a box of assorted odds and ends, nor is any time lost in changing a broken glass. I have had a gage


Packing nut hole opened out to fit shank of gland.
Gage column
Gland turned upside down.
Gland dispensed with and a 3/16 inch washer fitted, this is the best method as it allows return to use of ordinary packing if at any time leather type rings are not available.

GAGE GLASS PACKING

glass last, under my charge, twelve months, by reversing same, steam end for water. A curious phenomenon is that the steam end of the glass gets corroded and pitted in a remarkable manner. I attribute this to the use of soda in the boilers, to the possibility of weak acid solutions being present, and to the possible unstable composition of the glass under high temperature and pressure. With the older type of packing this curious happening is never seen, as the glasses never last a sufficient time.

An important advantage with these rings is that packing material simply cannot be forced over the orifice of glass, and so lead to "false water."

The British Admiralty have adopted a packing consisting of a stout tube of asbestos encasing a rubber ring in the interior, the asbestos being in two halves and the whole well black leaded. In this wise the resiliency of the rubber is preserved over a long period.

Actual gage glasses should be ordered to the dead length required with fused ends, not cut to length. Incipient cracks are present when the glass is cut to length, no matter how carefully, let alone when the time-honored round file is used. The glasses should be carefully annealed by the makers, the best of whom will furnish a guarantee that this has been done and that each separate glass has been individually tested to 1,000 pounds per square inch. In storing them care should be taken that they are not liable to be scratched. A wooden box should be kept and each glass should have an indiarubber ring slipped over to keep them from rubbing against each other.

The writer, who has had the inspection of many new boilers under his care, considers that sufficient trouble is not used by makers to insure linability of the gage glass mountings. A ground steel bar the full length of the gage and fitting both glass spaces is used by him to test this very important matter.

Gage glasses under steam should be protected from cold drafts of air. The necessity of this is apparent from the ordinary domestic lamp chimney.

One instance of the trouble which can happen at sea from repeated breakages occurred in a freight steamer on a twelve-day passage. Starting with over a dozen spare glasses on board, after seven days every glass had been used up, and a passing vessel had to be signaled and asked as a matter of courtesy for the gift of half a dozen. The engineers on her could get no sleep. It took one all the time to attend the boiler test cocks, and as usual the engineers per square foot of fire grate were not sufficient for the extra duty. The writer was a member of the crew of the signaled vessel.

The following, on a little understood but well-known phenomenon in connection with water gages, is due to the late chief examiner of engineers to the Board of Trade:

"When a water gage, clear in all its parts, has been blown through, the water in the glass rises above the level at which it formerly stood, immediately drain cock is closed. If left undisturbed for a time it gradually falls to its former position.

"The amount of rise depends chiefly on the temperature of the boiler and on the length of the pipes connecting the gage to the boiler. It frequently amounts to 4 inches, and the time needed to resume former level is from 30 to 40 minutes.

"The cause is twofold: (a) The displacement of the comparatively cold water in the water pipe to gage by hotter and proportionately lighter water from the boiler; (b) a slight condensation of the steam and corresponding fractional reduction of pressure in the steam pipe to the gage.

"The resumption of former level is caused by the converse of these actions added to the amount of air released from the steam condensed in the steam pipe to the gage, this lessening condensation.

"Another factor modifying the above causes is that if the water in the boiler be dense, the condensation of the steam in the gage causes the water in the lower part to be fresher and therefore lighter than that of the boiler."

London. A. L. Haas.

Making Your Own Graphite Paint

For making 10 gallons of good graphite paint, use 20 pounds of finely powdered or defloculated graphite, the balance to be made up of a good boiled linseed oil. Mix these thoroughly and then from thirty-six to forty-eight hours will be required for thoroughly drying. A small amount of drier can be used if it is preferred to dry the paint more quickly. The proportion of drier should be ½ pint to 5 gallons.

The writer has found from experience that the manufactured graphite is better for paint making than the mined variety, though some of the mined amorphous graphite will answer very well for this purpose. A graphite for paint making should run at least 90 percent graphitic carbon for the best results.

A good ready mixed graphite paint costs from $1.50 (6s. 3d.) per gallon up. By following the above receipt, a paint equal to any of the higher priced paints on the market can be obtained at about one-third the cost.

A Brother Engineer.

Marine Articles in the Engineering Press

Locating Friction in our Transportation Systems.—By R. H. Rogers. The chief cause of friction in transportation facilities is held to be the increased terminal charges. Two things are contributing to the rising terminal cost, which are congestion and a higher wage scale. The author points out how the expense of handling freight at terminals compares with the hauling of the same freight on a sea voyage or railroad journey. The use of electrical machinery is suggested as the most profitable application to the problem of reducing the cost of freight handling at steamship terminals. 3 illustrations. 1,400 words.—*General Electric Review,* March.

New Dry Dock at Manitowoc.—A new sectional steel floating drydock, which has a lifting capacity of 6,000 tons, has recently been built by the Manitowoc Shipbuilding & Drydock Company, Manitowoc, Wis., and established in Manitowoc harbor. The dock has an over-all length of 480 feet and a width of 70 feet between the wings on the keel blocks. The dock is composed of five independent sections, held together by a belt of 1¼-inch bolts, spaced 6 inches center to center, extending clear around the inside of the dock. The complete dimensions of the wings and pontoons, together with the general features of the framing and plating, are given in the article. Each section is equipped with an electric-driven turbine pump manufactured by the Rees Roturbo Manufacturing Company, Ltd., which has a rated capacity on a 20-foot head of 3,060 gallons per minute. The pump requires 25 brake horsepower to operate it, and as each section has its own pump the entire dock can be pumped out in about two hours. 5 illustrations. 1,300 words.—*The Marine Review,* March.

A Geared Turbine Cargo Steamer.—The steamship *Cairnross,* a ship 383 feet long, 51 feet beam and 7,850 tons deadweight capacity, with a speed of about 10 knots loaded, built by William Doxford & Sons, Ltd., of Sunderland, is a sister-ship of the *Cairngowan,* both of the vessels being owned by the Cairn Line of Steamships, Ltd. The former, however, is driven by two Parsons steam turbines geared to a single propeller shaft, while the latter is a single-screw steamer with the ordinary type of triple expansion engines. In the turbine-driven ship, the high-pressure and low-pressure turbines have each its own pinion on one side of the gear wheel, which is coupled to the propeller shaft, the whole of the gearing being inclosed in a cast iron casing. Eight large jets of oil are played on each of these pinions. There is no floating platform in connection with the gear, the thrust being allowed for by jaw clutches between the turbines and the gears, and these clutches have a certain amount of end play. The engine rooms of the two ships are of the same length, but the machinery of the turbine-driven ship is 20 tons lighter and, as this form of propulsion has shown better fuel economy, the turbine-driven ship is able to carry an appreciable amount more cargo on the same displacement. 5 illustrations. 1,900 words.—*The Engineer,* March 7.

A Comparative Survey of Battleship Design.—The 13.5 and 14-inch gun ships. This article is a continuation of an article published under the same title which was reviewed in our January issue. It discusses only those ships carrying 13.5 and 14-inch guns, of which some forty-two are built, building or projected. The various ships of this class belonging to the different nations are described and compared as regards their offensive and defensive powers. Various designs are criticised to show what the author considers as the chief defects of the different ships and how they might be improved, as, for instance, in the *King George V* class, the chief defect is pointed out as the inadequate secondary battery, which in this case consists of only 4-inch guns. The weak point in the designs of the United States battleships *Texas* and *New York* the author considers to lie in the method of armor distribution, although this fault is common to their contemporaries. One point in particular is noticeable in the types dealt with, and that is the universal acceptance of the center line and raised turret arrangement. No tendency is evinced to increase the caliber of the secondary guns beyond 6 inches, nor to mount an excessive number of torpedo tubes, except in Germany. The speed remains in the region of 20 to 22 knots, and the internal combustion engine for propulsion has not yet materialized in the battleship. Big guns show signs of reaching a maximum caliber within the next few years, and the 1,000-foot ship is coming into practical perspective. All this points to the completion of the steam-driven ship era within the next decade and the commencing of a new cycle of motor warships, probably starting at small dimensions. 5 illustrations. 2,700 words.—*The Shipbuilder,* March.

The Quadruple Screw Steamer Reina Victoria Eugenia.—The *Reina Victoria Eugenia* has been built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., at their Neptune Works, Newcastle-on-Tyne, to the order of the Compañhia Transatlantica of Spain, and is intended for service between Italian and Spanish ports and the River Plate with mails, passengers and emigrants. The vessel is 500 feet long over all; 480 feet long between perpendiculars; 61 feet molded breadth; 61 feet 3 inches extreme breadth; 35 feet 9 inches molded depth to upper deck; 10,000 tons gross tonnage; 18½ knots speed; total capacity for passengers and crew, 2,387. The vessel is built of steel, the scantlings and construction being in accordance with the requirements of Lloyds register for their 100 A-1 shade-deck class. A cellular double bottom, 4 feet deep, extends the full length of the vessel between the peak bulkheads. The double bottom is divided into eight transverse compartments, five of which are further subdivided by a central watertight division, providing ample space for water ballast. The watertight subdivision of the ship is further accomplished in a very complete manner by nine transverse watertight bulkheads, which extend to the upper deck. The compartments beneath the lower deck are devoted to cargo, bunker and machinery spaces. Forward there are two cargo holds and aft two more. Between the cargo holds, commencing from forward, are a reserve cross-bunker, a second cross-bunker with a recess for one boiler, the boiler rooms, then another cross-bunker, aft of which is the engine room, and then the dynamo room and thrust recess. The passenger accommodations and appointments of the vessel are described in detail. The vessel is propelled by four screws, which are driven by reciprocating engines and turbines arranged on the combination system. Each of the two inner propellers is driven by a set of four-crank, triple-expansion reciprocating engines, with cylinders 29 inches, 43 inches, 47 inches and 47 inches diameter by 42 inches stroke, while each of the outer screws is driven by a low-pressure turbine of the Parsons type. Steam is supplied by seven single-ended boilers, working under Howden's system of forced draft. 3 illustrations. 2,200 words.—*The Shipbuilder,* March.

Liquid Fuel as a Source of Energy for the Propulsion of Ships.—By C. Zulver. For a number of voyages of the same ship, with boilers burning either coal or oil, and the engines kept running as nearly as possible in the same condition as regards vacuum, revolutions, etc., it has been found that in a ship with a deadweight-carrying capacity of 7,700 tons there is a mean saving by weight in fuel consumption of 33 percent

when oil is used as fuel instead of coal. As a direct consequence it was found that the ship carried about 150 to 200 tons more cargo, and also an appreciably better speed has been maintained by the oil-fired steamer. In connection with the Diesel engine the author points out that the fuel consumption of the *Vulcanus* has not exceeded 2 tons of solar oil per day, which is only about one-fifth of the coal consumption of a steamer of like capacity, while the cargo-carrying capacity of the *Vulcanus* is from 12 to 15 percent more. Particulars are given as to the performances of the motor vessels *Vulcanus* and *Juno*, and complete details are also given of the various oil-burning systems. The author asserts that oil fuel can be used with practically any type of steam boiler, the methods chiefly in favor being mixing the oil with a steam jet and heating and atomizing it by means of a steam burner, or using compressed air burners or the direct pressure systems. In discussing the oil engine, the author favors the four-cycle engine as compared with a two-cycle marine engine. The features which in his opinion are drawbacks in the two-cycle engine are: (1) Double heat generation of pistons; (2) ports in the bottom of the cylinders, making a permanent tightness of a liner doubtful; (3) complications with scavenging pump; (4) higher fuel consumption; (5) no relief to moving parts, thus necessitating larger bearing surface; (6) long trunk piston necessary to close ports in the bottom of cylinder. Illustrated. 8,000 words.—*Institute of Marine Engineers,* February.

The Electric Propulsion of Ships.—In an editorial discussion of the application of electricity to the propulsion of ships, it is pointed out that electric transmission is by no means a new departure, and it is suggested that the main reason why this form of propulsion has not been adopted on a large scale is not that the claims put forward by the advocates of electric propulsion are in any way impossible, but that simply from the small amount of practical evidence available from actual installations it is unlikely that the majority of shipowners would be prepared to give much attention to the proposals. The need of practical evidence from installations carried out on a large scale is strongly emphasized. The two large installations now under way—namely, the United States collier *Jupiter* and the Diesel electric ship being built by Messrs. Swan, Hunter & Wigham Richardson—are pointed out as likely to do much towards building up such evidence, although these two cases cannot, of course, prove the case for any general adoption of marine electric transmission. Electric transmission seems to have greater advantages for warship propulsion than for use in merchant vessels, since in warships a greater variation in speed is necessary with economical operation of the propelling machinery at both low and high speeds. Such a matter is of little interest in connection with either passenger or tramp ships which operate almost wholly at full speed. 1,400 words.—*Engineering,* Jan. 17.

Recent Experiences with Babcock & Wilcox Boilers.—By W. J. H. Rosenthal. Since the trials made by the Admiralty Special Boiler Committee of 1900, the Babcock & Wilcox boiler has been very extensively adopted for large naval vessels. In the mercantile marine up to June, 1912, 542 Babcock & Wilcox boilers had been fitted in 253 ships, the total horsepower being 411,479. Installations had shown that the essentials for the successful use of watertube boilers were: (1) Well constructed and tight condensers; (2) the use of as little oil as possible in the engine cylinders and proper means of filtering the feed water; (3) evaporators of adequate size; (4) regular examination of the water in the boilers, and (5) a careful and interested engineer. The conditions are regularly attained at the present time in all well-engineered vessels. A comparison of the cross-channel steamers *Victoria* fitted with cylindrical boilers, and *Engadine* fitted with Babcock & Wilcox boilers, showed that on seventy-nine and ninety-four double trips, respectively, the *Victoria* attained an average speed of 21.272 knots and the coal used was 24.59 tons per trip, while on the *Engadine* the figures were 22.367 knots and 24.77 tons. It has also been found that on the Stranraer and Larne service there is economy in fuel in favor of the *Princess Victoria* over the *Princess Maud,* a sister-ship of the same power, but fitted with cylindrical boilers. In the case of three sister-ships of 8,000 tons displacement, engaged on the passenger service between New York and New Orleans, the average consumption for a series of voyages was as follows: Steamship *Creole* fitted with Babcock & Wilcox boilers, 1,149 tons; steamship *Momus,* with cylindrical boilers, 1,412 tons; steamship *Antilles,* with cylindrical boilers, 1,336 tons. In an intermediate passenger steamer of 5,000 horsepower it has been estimated that by fitting Babcock & Wilcox boilers there would be an increase of heating surface of 23 percent, an increase of grate surface of 34.3 percent, a saving in weight of 225 tons, a saving in floor space of 14.33 percent, and a saving in fore-and-aft length of 12 feet. Furthermore, steam can be raised more quickly; devastating explosions and the risk of detrimental strains due to forcing would be avoided, and the boiler would be more suitable for higher pressures.—*The Institute of Marine Engineers,* March.

The Oddie Simplex Feed Pumps and Air Pumps.—A detailed description is given of pumps fitted with Oddie's patent simplex valve gear, a gear which has come into use largely in late years in connection with marine work. The action of the Oddie simplex pump is in reality based on the same principles as that of the duplex pump, for the single valve of the Oddie pump, it is claimed, takes the place of the second piston of the duplex pump, with the important difference that with the Oddie pump the reversing of the piston can only take place after the stroke has been completely finished. Another advantage is that the gear positively controls the working of the steam by mechanical means throughout the whole length of the stroke. The control of the piston is so regulated during the stroke that a motion very like that of a crank-moved piston is obtained. This is quite independent of the reversing movement at the end of the stroke, and is peculiar to the Oddie pump. It is, moreover, the cause of the working of the pump being very quiet and smooth even at the highest speeds. Two types of pumps are described, the feed pump and the air pump. The mechanical distribution of steam by the action of the single valve, which combines the functions of an auxiliary distributing expansion and reversing valve, is peculiar to the Oddie system and forms the characteristic difference between this system and others. It possesses the important advantage that the piston motion starts slowly and without shock, is accelerated to the middle of the stroke and then gradually slows down towards the end of the stroke. In the description of the Oddie air pump the difficulties encountered with the application of the commonly used three-valve type of pump when coupled to a single steam cylinder, are pointed out, and it is claimed that the Oddie air pump surmounts these difficulties entirely. In the Oddie air pump air and water are not only drawn in on the upstroke, but are also drawn in for a large portion of the down stroke. In the Oddie pump the displacement per double stroke is far higher than in a pump of the ordinary three-valve type. Further, in the Oddie pump the work is better divided between upward and downward strokes and the pump can, therefore, be run quicker and quieter than a pump of the three-valve type. The Oddie pumps are manufactured by the Machinenfabrik Odesse G. m. b. H., Oshersleben, Germany. 19 illustrations. 1,900 words.—*Engineering,* Jan. 31.

New Books for the Marine Engineer's Library

A New Book on Steam Turbines

REVIEWED BY PROFESSOR C. H. PEABODY*

Design and Construction of Steam Turbines. By Harold Medway Martin, Whitworth Scholar. Size, 7½ by 10¾ inches. Pages, 372. Illustrations, 523. London and New York, 1913: Longmans, Green & Company. Price, 25s. net.

It may not be faimiliar to all our readers that the celebrated engineer Whitworth left a fund for the liberal education of a few selected men of exceptional ability, and that custom, which is stronger than law, has required that, whatever other training these young engineers might have, they must become proficient in mathematics. The selection and training of these men are greatly valued by themselves and by the public, so that there is no prouder title than Whitworth Scholar, and the work done by Whitworth Scholars has abundantly justified the establishment of the fund; this book is a worthy example of their accomplishments.

The book is written as a manual for engineers and is neither intended nor adapted for students in technical schools, or perhaps it may be said that such students may read it to best advantage after a good course of instruction in steam engineering and steam turbines.

The book is divided into several parts, as follows: (1) A statement of rules and formulæ, without proof, including the use of the Mollier diagram; (2) a general method for the preliminary design of any steam turbine; (3) designs of various types of turbines, such as impulse turbines, velocity compound turbines, reaction turbines, and radial flow turbines; (4) a brief discussion of thermodynamic principles; (5) such features of the design and construction of turbines as balancing, labyrinth packings, high-speed bearings, gearing and condensers; (6) detailed description of various types of turbines with dimensioned drawings.

The relative values of the different parts of this manual may be considered to be in general in the order of the divisions. The first part of the book presents just those features that the trained designer (who has learned, digested and passed into his subconsciousness the theory of turbines) must have at hand, presented by a master of the subject with the mathematical ability to deal with abstruse theories, and the wisdom to abstain from prolixity. Here one finds those methods and details that have been developed by turbine builders and at their proper discretion withheld from general dissemination.

The author's method of provisional design is most happy, as it allows the designer to determine quickly the general proportions and dimensions of his design and its efficiency, and thus avoid a repetition of the elaborate computations for a complete design that might be required if undertaken without knowing whether the design when completed would conform to practical limitations.

The Parsons type of turbine, predominant in England, naturally receives most extensive treatment, and this is most welcome to American engineers, who in general have less information concerning this type. Since the customary construction places blades in groups, special importance is given (in two complete chapters) to the flow of steam through groups of blades, both theoretically and practically.

Radial flow turbines involve the combination of thermodynamic and centrifugal actions on the steam, and in general receive scant attention from writers, and consequently the author's chapter on that type and the application to the Ljungström turbine is most welcome

The thermodynamic treatment of the author is perhaps sufficient for a book of this character, but the reviewer cannot agree that there is any necessity for the approximate computation of velocity by the aid of exponential equations, even though the author controls his exponents so that his approximations are sufficient. So long as blades are arranged in groups which commonly have both equal length and constant angles, computations by ordinary thermodynamic methods for steam, whether by aid of tables or by aid of Mollief's diagram, can readily be made; even if the blades are "gaged" for constant velocity in a group such allowance presents no special difficulty on the theoretical side. The heat assignment for a group is large enough to be determined from Mollier's diagram, and the fractional proportion for a single stage can be assigned with sufficient precision.

In discussing the difficult subject of balancing, the author says: "Whatever this natural period of vibration [of the loaded shaft] may be, it is easy to understand that, should the rate of revolution coincide with this rate, resonance effects may ensue, augmenting the range of oscillation beyond all limits." May not this be the crux of the whole matter, at least for shafts with considerable rigidity? For then the deflection and the period of vibration can be found, and hence the critical speed.

The author's method of calculating leakage through dummy and gland packings of the type commonly called labyrinth, though subjected to criticism when first published in *Engineering*, appears to be fairly well founded, and deserves careful comparison with experiments. It is to be noted that his equation indicates that a relatively small number of rings should suffice; thus with 150 pounds absolute for the internal steam pressure and atmospheric pressure outside, six rings appear to give only one-twelfth more leakage than thirteen rings. Some experiments at the Massachusetts Institute of Technology (unpublished) indicate that the fall of temperature and pressure takes place principally at the last four or five rings. And yet a large number of rings are used in practice.

High-speed bearings have received more application in connection with steam turbines than in all the rest of engineering work, and are therefore of special interest. The author points out clearly that horizontal bearings for high speeds must run hot, and that reduction of length of bearing appears practicable, though turbine designers have so far been very conservative.

To the designer a collection of dimensioned drawings is of great value, and those given by the author will be appreciated, though caution is necessary, as the author does not, and perhaps cannot, give the limits of the legal protection that the patentees of the various types enjoy. With these drawings are given descriptions of the various turbines, though perhaps we should rather consider the drawings as part of the description. Though this part of the work occupies nearly half the bulk, the author has found it necessary to condense his description—and description of complex machinery, whether or not compressed in space, is very difficult; this is contrary to a common idea that any one who understands a machine can give a clear description of it. Such description may not be classical literature, but if it does not conform to the fundamental ideas of literature it fails of its purpose, which is to convey ideas to the reader with the least resistance.

The book is well printed, finely illustrated and strongly bound. Though there are two lists of errata, not all of the typographical errors have as yet been found. The reviewer, who has received deserved blame for similar delinquency, can only offer his sympathy, for he believes that even the greatest care and solicitude may fail in such matters.

* Professor of Naval Architecture, Massachusetts Institute of Technology, Boston, Mass.

Convenient Handbooks

Engineering Handbook on Patents. By William Macomber. Size, 4⅜ by 6¾ inches. Pages, 288. Boston, 1913: Little, Brown & Company. Price, $2.50 net.

A thorough understanding of what a patent is, what is patentable, how to obtain patents, patent litigation, property rights, etc., would save the expenditure of a good deal of time and money which is now wasted. The handbook which we have under review, while it is addressed especially to engineers, will be found of use to inventors and manufacturers generally. The author of the book, who is a leading patent lawyer and professor of patent law in Cornell University Law School, states in the preface that the book is by no means a treatise on patent law, nor is it a textbook, but that it is simply a handbook in which are presented in simple language, omitting entirely legal phraseology and terminology the theories which underlie successful inventions and which tend to guid the inventor along successful lines. A careful study of this book would undoubtedly enable the user to avoid the lines of thought which have resulted in past failures of other inventors, and will inform him of the steps necessary to secure for himself the full benefits of a successful invention.

Steam Boiler Construction. By Edward G. Hiller. Size, 5½ by 8¼ inches. Pages, 167. Illustrations, 117. Manchester, England, 1912: Taylor, Garnett, Evans & Company, Ltd. Price, 1s.

This book contains the rules of the National Boiler & General Insurance Company, Ltd. (of England), together with notes on material, construction and design of steam boilers and similar vessels. The book is written by the chief engineer of this boiler insurance company, and while the results and notes which he gives embody the principal features of this particular insurance company, they are also based on the experience and experiments of various authorities. The book is, of course, a short one, and much has been omitted that one would expect to find in a comprehensive treatise on boiler construction. The information relates particularly to English practice, which in many essential features is quite different from American practice. Most of the commonly used types of boilers are described rather briefly, including Lancashire and Cornish boilers, vertical boilers, locomotive boilers, marine boilers and the various types of watertube boilers. Some chapters which are of particular value to boiler makers are those relating to riveting, welding, reinforcement of manholes, mudholes and other openings in boiler shells, the staying of flat and curved surfaces and the reinforcement of cylindrical furnace flues, etc. In the final chapter some references are made to the principal boiler fittings.

Book of Standards. (National Tube Company.) Size, 4 by 4½ inches. Pages, 559. Illustrations, 136. Pittsburg, 1913: National Tube Company. Price, $2.00.

For some years the National Tube Company, which manufactures boiler tubes, wrought pipe, water and gas mains, mechanical tubing, miscellaneous forgings and malleable, cast iron and brass fittings and valves, has published at intervals a convenient handbook, in which are given all of the dimensions and data pertaining to the tubular goods which the company manufactures. The handbook which is published this year contains, besides the data regarding the manufactured products, a good many pages of valuable information on certain subjects which are closely related to the uses of pipe and tubes. The engineering data given were obtained in all cases from well-known engineering authorities. Two of the subjects which are of particular value to marine engineers are the strength of pipes under internal fluid pressures and the determination of collapsing pressures on pipes or tubes subjected to external pressure. Separate sections are given to the discussion of the physical properties of gases, the flow of gas in pipes, the properties of steam, both saturated and superheated, the flow of steam through orifices, and the loss of heat from steam pipes. The foregoing are only a few of the many subjects which are discussed in the handbook. In every case the data given are thoroughly up to date, and are presented in a very clear and convenient form by means of tables, formulæ and diagrams which may be readily interpreted. The book has been well indexed and is a convenient source of information for the engineer.

Personal

William E. Waterhouse, naval architect and engineer, has removed his offices to the Whitehall building, 17 Battery Place, New York.

G. P. Stephens, formerly of W. & A. Fletcher Company, Hoboken, N. J., is now in charge of the boiler department of the Skinner Shipbuilding & Dry Dock Company, Baltimore, Md.

Mr. Greensmith, formerly in charge of the machine department of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., became associated, March 1, with the Skinner Shipbuilding & Dry Dock Company, Baltimore, Md., to take charge of their machine department.

H. McL. Harding, consulting engineer, Department of Docks, New York City, has sailed for Europe to make an extensive study of mechanical appliances employed in the transferring of miscellaneous cargoes and package freight at the river ports and railway terminals. Mr. Harding will also visit many foreign works where freight-handling appliances are manufactured.

Obituary

Sir William H. White, K. C. B., F. R. S., died suddenly, February 27, in London from a paralytic stroke. Born in Devonport in 1845, he began his lifework by entering the Devonport Royal Dockyard as an apprentice shipwright. While there, in 1863, he won an Admiralty scholarship and entered the newly-established Royal School of Naval Architecture at South Kensington. Graduating from the school in 1867 with the highest honors, he entered the Admiralty immediately, and was promoted to the rank of Assistant Constructor in 1875, advanced to Chief Constructor in 1881, and after being associated for two years with the warship building department of Armstrong & Company, he returned again to the Admiralty, becoming head of the Constructive Department, holding the offices of Director of Naval Construction and Assistant Controller of the Royal Navy from 1885 to 1902, when his retirement became necessary on account of ill health. During the seventeen years when he was at the head of the Constructive Department of the Admiralty he was responsible for the design and construction of 245 vessels. Outside of his Admiralty work, Sir William White was for over ten years professor of naval architecture at the Royal School of Naval Architecture, and since leaving the Admiralty he has been identified with many important interests. His book on "Naval Architecture," first published in 1877, has become a classic in engineering literature. He was a liberal contributor to many engineering and scientific societies and always took a leading part in the proceedings of such societies. He had served as president of most of the leading engineering societies in Great Britain, and many honors were bestowed upon him by universities and societies, both at home and abroad.

American Society of Marine Draftsmen.—A meeting of the Delaware River Branch of the American Society of Marine Draftsmen was held in Philadelphia, Pa., March 14, at which Mr. George W. Dickie, naval architect, of San Francisco, Cal., presented a paper on "The Engineer."

ENGINEERING SPECIALTIES

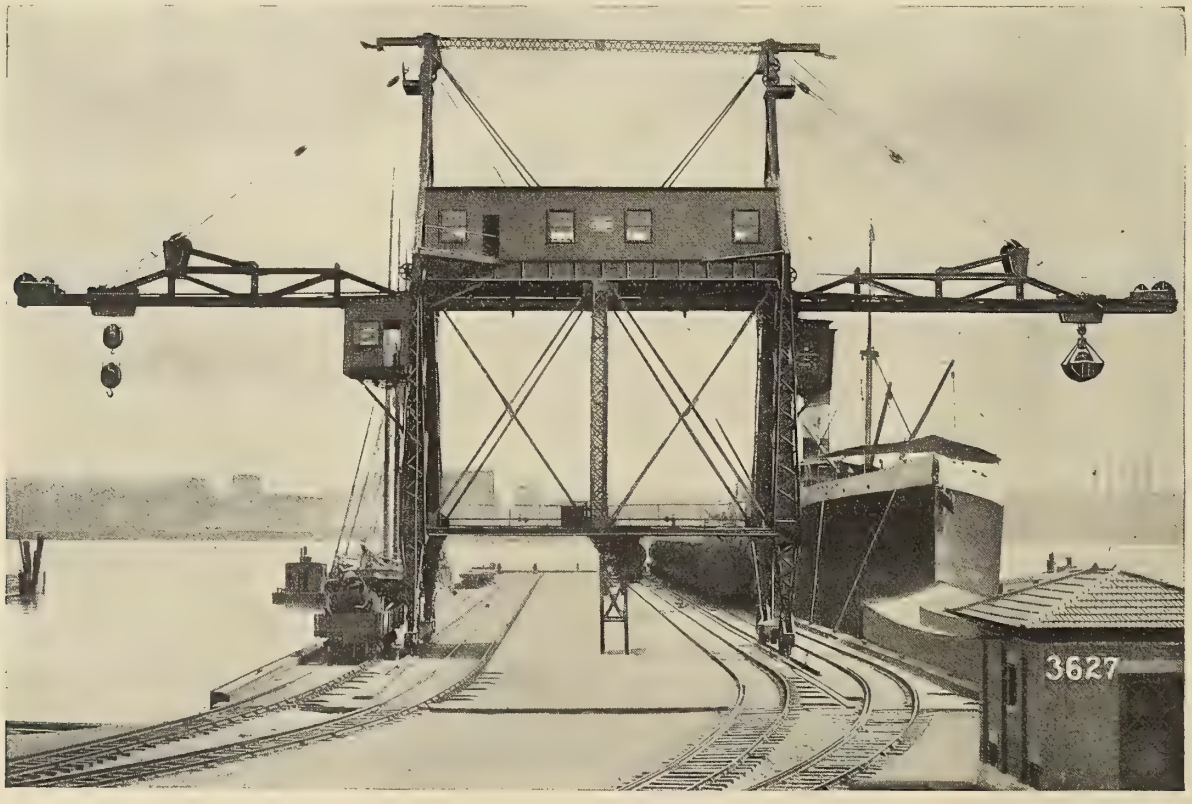
Fay Template Board

The Fay Manilla Roofing Company, Camden, N. J., has on the market a new material especially adapted for template work in shipyards. Laying off by the mold system is generally recognized by shipbuilders as the cheapest method of laying off ship plating, bulkheads, tank tops, frames, etc. In fact, laying off such work from templates made in the mold loft, even when the molds are made of wood, as was formerly the custom, costs only about one-third as much as laying out each piece separately in the yard. Wood templates, however, entail a heavy expense for material and labor, besides encumbering the mold loft on account of the bulk of the material, and so the use of a material such as the Fay template board, which is practically a very stiff, thick paper, specially prepared to resist tearing, distortion or shrinkage from rough usage, makes it possible to reduce the cost of the mold system very materially by the saving in labor and material. Templates made on Fay template board, which is supplied in rolls 105 inches wide, containing 2,000 square feet to the roll, can be rolled up and stowed in racks or bins, where they are ready for use at a moment's notice as often as they are needed.

Tarred Rigging

The use of tarred rigging is now of less interest to the seafaring man than formerly because of the rapid and extensive development of steam power. However, tarred rigging is used to-day on craft of various types to such an extent that the production of tarred goods is an important branch of the cordage industry. The tar best suited for cordage comes from various members of the pine tree family, and is obtained by the distillation process, either by using the old kiln or by modern retorts. It is conceded that the kiln-made article is superior for tarred rigging, and therefore it is used principally in making first quality tarred rope. The tar, as it comes from the kiln, is poured into barrels which are shipped to the cordage works. The way this tar is handled and how it is made to penetrate and adhere to the yarn, as is done by the Plymouth Cordage Company, North Plymouth, Mass., may be described as follows:

The tar is heated to 200 degrees or more in tanks from which the liquid feeds into long copper-lined troughs, where the tarring takes place. Through these "coppers," so called, run steam pipes to further regulate the temperature. Excessive heating would cause the loss of the tar's good qualities, and to prevent this the supply in the "coppers" must be freshened frequently. As the yarns, heavily saturated with tar, come from the "copper" they are compressed between two rollers, adjusted to leave in the yarn as much or as little tar as needed for the particular goods being made and to turn back the surplus. The pull which carries the yarn through the tar and between the rollers comes from two large drums, around which the yarns travel preparatory to reeling on to the friction-driven receiving bobbins. Goods of nine-thread size and under are usually tarred in the completed rope form, but the process is essentially the same as with the yarns. The rich golden brown color of the tarred goods—an outward sign of right materials and methods—has become recognized as the Plymouth mark of the weather-resisting qualities contained in the goods.

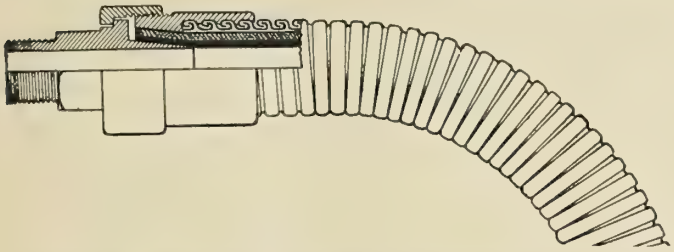


A Direct Unloader

This illustration shows a unique unloading device, designed and built by the Dodge Department of the Link-Belt Company, Chicago and Philadelphia, for the New York Central & Hudson River Railroad at Weehawken, N. J. It is fitted with movable booms and equipped with independent hoisting and trolleying machines for each boom, arranged for operating a 40-cubic foot self-filling bucket for handling coal, ore, sand, sulphur, etc., or it may be equipped with hanging blocks for handling 5-ton or 10-ton loads of miscellaneous materials. Both booms may be operated simultaneously or independently, all of the operations being performed by alternating-current motors.

A New Flexible Hose that Doesn't "Kink"

Users of hose or flexible connectors for steam and pneumatic service have always sought for a high-pressure hose that wouldn't kink, flatten, puncture or collapse at inopportune moments. Troubles of this nature have become so common with ordinary hose that they are accepted as a matter of course, to be dealt with philosophically, just as other vexing problems are met in the course of daily routine, but a new coupling known as the J-M Flexible Metallic Combination Hose has been placed on the market by the H. W. Johns-Manville Company, of New York, which is said to have overcome these difficulties. This connector consists of a superior grade



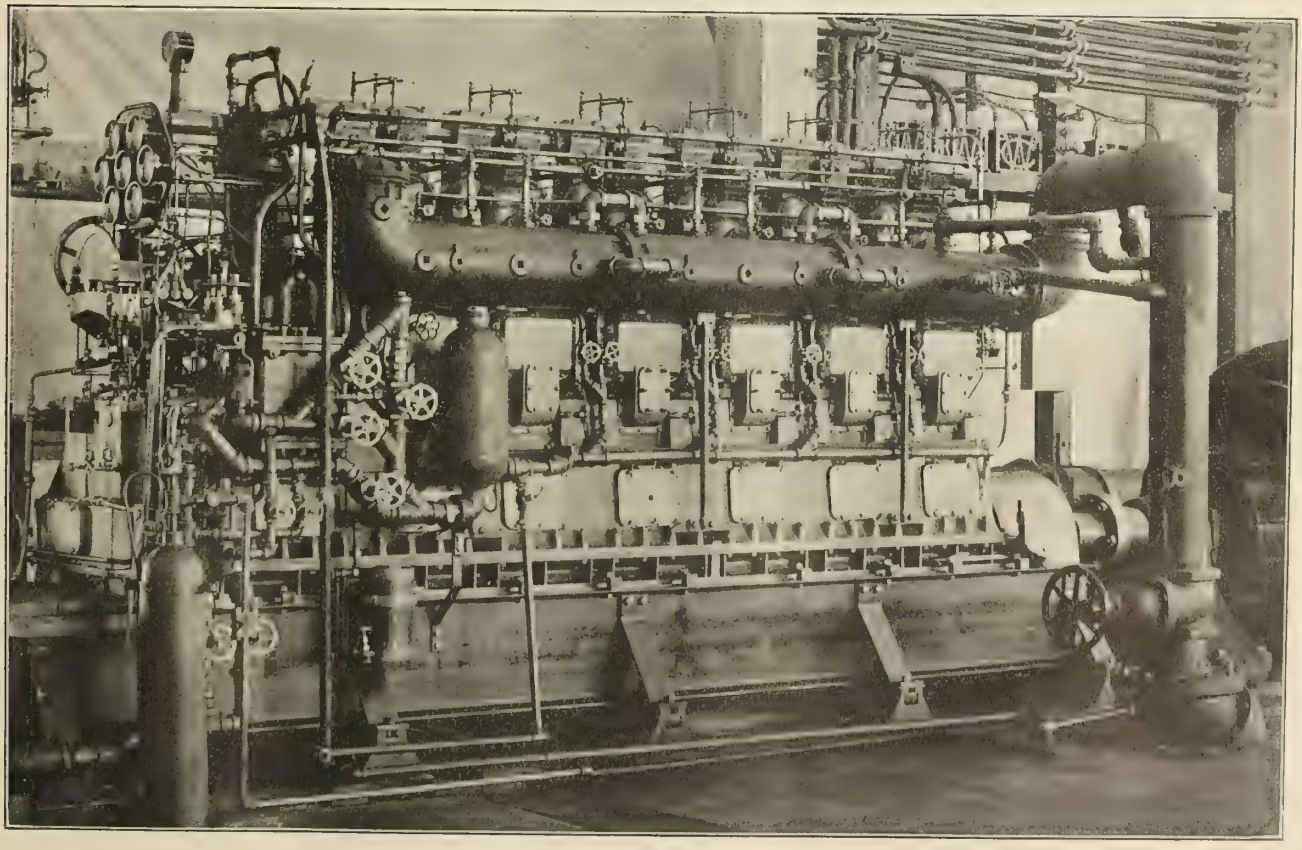
of durable rubber hose, protected against outward injury by a stout metal armor made in the form of a ribbon, with crimped edges, forming, when wound, a continuous, interlocking flexible spiral, which is said to be practically pressure-tight in itself without the inner tube. As the interlocking construction of the spiral restricts the curvature, sharp bends are impossible. Consequently the inner tube cannot kink or flatten, and is always open to its full diameter, permitting an unrestricted flow of steam, gas or fluid. Owing to its unusual strength, the armor is practically proof against damage from the outside, and the substantial construction of the armor permits the use of a much lighter inner tube than is ordinarily used. The exterior surface of the hose, it is claimed, does not become excessively hot when used for steam service, drills, blowing out boilers, etc., and therefore can be conveniently handled under such conditions. Further, there are no rough edges in the metal armor to cut or chafe the inner tube or to cut or scratch the hands of the user.

Specially designed couplings of malleable iron or brass are furnished with each length of hose.

J-M combination hose can be furnished in any length, in any inside diameter up to 12 inches, of any metal, and for all working pressures. It is also made with an inside pressure-tight metallic lining as well as outside metal armor, for suction service, oils, etc.

Full-Power Endurance Test of a 300 Horsepower Marine Diesel Engine

One of the 300-horsepower high-speed Diesel engines, built by the New London Ship & Engine Company, Groton, Conn., for a foreign government was recently placed on the test stand and subjected to a full-power continuous 72-hour run at 500 revolutions per minute. The engine required very little attention during the trial except for the occasional replenishing of the fuel tanks. Although the engine ran for three days and nights at full power there were no indications of undue heating, and, although observations of pressures and temperatures were taken every hour during the test, there was no change from the beginning to the end. The fuel consumption averaged .57 pound per horsepower-hour, which, compared with from 2 to 3 pounds of coal per horsepower-hour usually required in a steam engine, means that the vessel in which this Diesel engine is to be installed can travel on a ton of oil from four to five times the distance it could travel on a ton of coal if fitted with steam engines. The consumption of lubricating oil was about 1 gallon per hour. No attempt was made to economize on the consumption of lubricating oil, for the reason that the test was considered very severe; in fact, this is believed to be the longest full-power endurance trial ever made on an engine of the same general type, and the performance of the engine speaks well for the excellency of the work turned out by the builders.



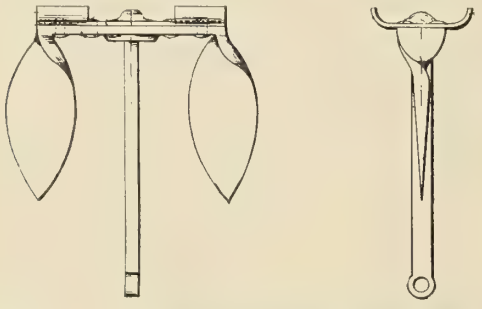
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,047,155. ANCHOR. SEELEY P. BIRDSEY, OF MIDDLETOWN, CONN., ASSIGNOR TO WILCOX, CRITTENDEN & CO., INCORPORATED, OF MIDDLETOWN, CONN., A CORPORATION OF CONNECTICUT.

Claim 1.—In an anchor, the combination with a member, made of a single piece of forged or rolled metal, terminating at both ends in a fluke bent at substantially a right angle to the intermediate portion; of



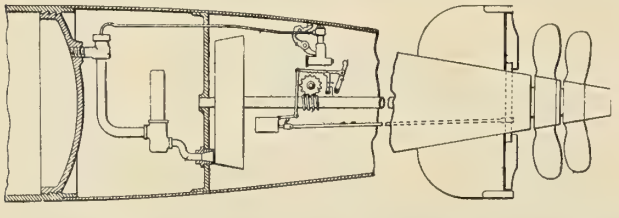
a plate secured to said member substantially parallel with said intermediate portion and forming a reinforcement therefor; and a shank pivotally connected between said member and plate. Five claims.

1,048,068. BOAT SADDLE. ELIAS GUNNELL, OF MANITOWOC, WIS.

Claim 1.—In a boat saddle, the combination with a base, of a pair of cross-arms pivoted together and resting for relative movement on the base, and flexible members secured to the lower ends of the cross-arms provided with means adapted to engage the edges of the boat. Eighteen claims.

1,044,543. STOPPING DEVICE FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF SMITHTOWN, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

Claim 3.—In a torpedo, a timing device comprising a traveler moving from a starting to a stopping point, means for stopping the normal run



of the torpedo operated when such traveler reaches its stopping point, and means operated from the steering mechanism and adapted to stop the movement of the traveler and restore it to its starting point. Nine claims.

1,046,675. BOAT-HANDLING DEVICE. GEORGE W. SWEDENBORG, OF ASHTABULA, OHIO.

Claim 1.—In a device for handling boats, the combination with a vessel having an upper and a lower deck, of a davit pivoted upon the upper deck, a boat suspended from the davit outside of the vertical through the davit pivots so as to tend to cause the davit to swing upon said pivots, means operable from the lower deck for normally holding the davit against such swinging movement, mechanism for controlling the swinging movement of the davit, such movement bringing the boat substantially opposite the lower deck and means adapted to be under control of persons in the boat for lowering the latter below the lower deck. Seventeen claims.

1,050,058. GAS BUOY. NELSON GOODYEAR, OF NEW YORK, N. Y., ASSIGNOR TO BROOKS H. WELLS, OF NEW YORK, N. Y.

Claim 1.—In a gas buoy the combination of a body or float having a chamber carried by the float open to the sea water, and means controlled by the level of the water in said chamber for feeding carbide to water. Forty-one claims.

1,050,045. SELF-RIGHTING AND SELF-BAILING BOAT. EINAR L. M. SIVARD, OF BROOKLYN, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO ASTOR TRUST COMPANY, TRUSTEE, A CORPORATION OF NEW YORK.

Claim.—In a self-righting boat, the combination with air-tight compartments on each side thereof, of a longitudinally-extending tank having sides inclining from the bottom of the boat toward the center line of the deck so as to form a tank substantially triangular in cross-section, a valve in the bottom of the tank adapted to open automatically to admit water thereto and to close to keep the water in, and an independent air-escape valve normally retained in open position to permit the escape of air during the filling of the tank and adapted to close to retain water within the tank when the boat is capsized. One claim.

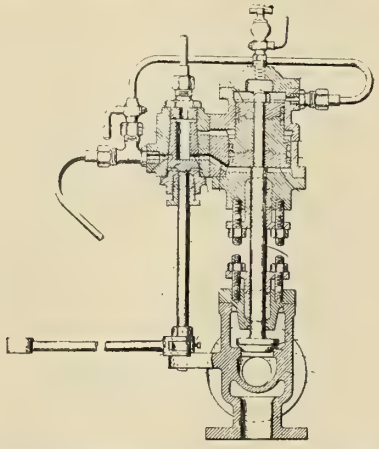
British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

26,136. IMPROVEMENTS RELATING TO THE PROPULSION OF VESSELS. J. I. THORNYCROFT & CO., LTD., OF WOOLSTON WORKS, WOOLSTON, HANTS.

In connection with the propulsion of ships by turbines and internal combustion (Diesel) engines with means for enabling the same to be used alternatively for high and low speeds respectively in order to reduce the power absorbed by the turbine plant when the Diesel engines are propelling, a branch pipe leading from near one end of the exhaust receiver of the Diesel engine is connected to a steam generator of any known or suitable type so as to utilize the heat of the hot exhaust products of combustion from the engine for generating steam which is admitted to the turbines (not shown), any steam in excess being used in the engine driving the air pumps or other auxiliaries.

28,819. STEAM STEERING GEAR. T. GRIEVES, OF WATERLOO VILLAS, BLYTH, NORTHUMBERLAND.

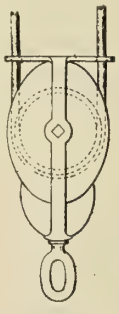
The invention relates to the control of the steam admission valve of steam steering gear for ships. The movements of the steering wheel are imparted to an arm giving a partial turn to the rod of a ported valve to put the inlet passage in communication with the port of the cylinder so that steam is admitted below the larger diameter of the piston and exhausted from the upper side of the piston. The steam so admitted overcomes the constant steam pressure in the space above the



lesser diameter of the piston and thereby forcing the piston up and raising the control valve which admits steam to the engine. When the valve is brought back into mid-position with the exhaust passage in communication with the steam port the steam is exhausted below the piston and the constant pressure above again forces down the piston and closes the control valve.

11,461. SAFETY BLOCK FOR BOAT FALLS. E. EKBLOM, OF 76 AVENONS ROAD, PLAISTOW, LONDON.

This invention relates to improved safety blocks for use with boat falls, the object being to provide such blocks with means which will prevent them turning over when the weight of the boat is removed. To



this end each bottom block is provided at its upper end with a guide plate through holes in which the ropes pass. A weight may be provided, and for connecting a pair of blocks together side extensions may be provided.

27,629. IMPROVED SELF-DISCHARGING VESSEL OR BARGE. C. I. DAVIDSON, BILLITER STREET, E. C.

This invention provides a new or improved form of self-discharging vessel or barge by means of which fuel or other substances may be placed on board other vessels or barges or on shore. This invention consists in the provision of V-shaped depressions having semi-circular troughs in their bottom angles formed by the bottom of the hold and fitted with screw conveyors for trimming the cargo to a well formed in the hold from which the cargo is raised, elevating bucket dredgers and from the elevating element, screw conveyors carrying the cargo to the required point of discharge. The discharging conveyor is fitted in a carriage capable of slewing the conveyor vertically, horizontally and also running it inboard and outboard. Portable screw conveyors for carrying cargo from the discharging conveyor to a further point inaccessible to the discharging conveyor, may be provided.